RADIOLOGY

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RADIOLOGY

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The Roentgen Appearance of the Pulmonary Veins in Heart Disease[1]

HOWARD L. STEINBACH, M.D., THEODORE E. KEATS, M.D., and GLENN E. SHELINE, Ph.D., M.D.

THE DEGREE OF vascularization of the lungs has long been used as a diagnostic aid in the roentgen interpretation of acquired and congenital heart diseases. It has been observed that in cardiac lesions in which there is pulmonic infundibular or valvular stenosis the peripheral vascularity is decreased, whereas, with intracardiac shunts carrying blood from the left side of the heart to the right side, the volume of pulmonary circulation is increased. The presence of diminished vascularity has served as one of the criteria for the performance of various surgical procedures to increase the pulmonary blood flow in patients with cyanotic heart disease.

There are cases in which it is difficult to evaluate the pulmonary circulation on plain roentgenograms of the chest. Post-stenotic dilatation of the pulmonary artery, which is frequently associated with pulmonic valvular or infundibular stenosis, may give the impression that the flow is increased, whereas it is usually decreased. The post-stenotic dilatation is limited to the main branches of the pulmonary artery, with the hilar vessels ordinarily appearing normal and the peripheral branches decreased in size. Occasionally the dilatation will extend to the hilar vessels, particularly the left. In small intracardiac shunts and rheumatic heart disease, there is frequently only a very little change in the appearance of the peripheral pulmonary circulation.

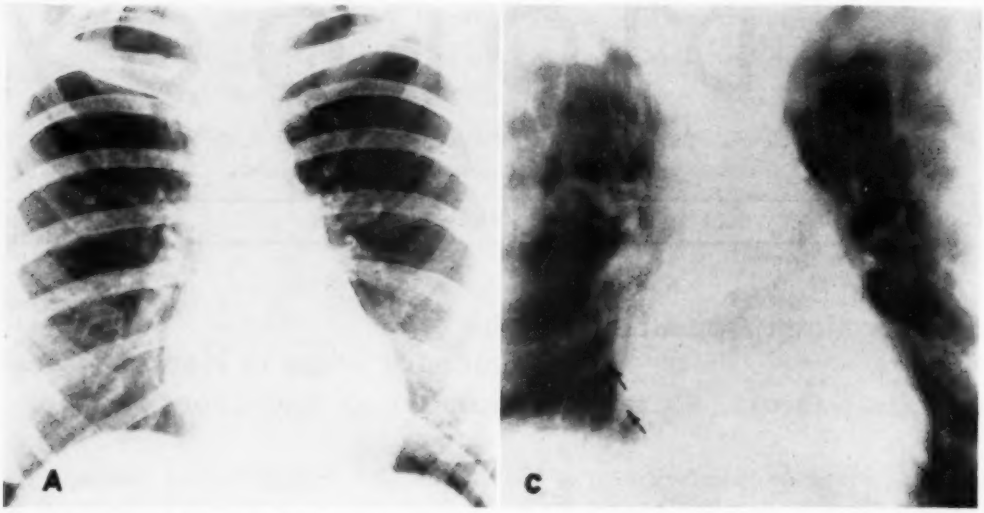
Because of these difficulties an attempt was made to evaluate separately the appearance of the pulmonary arteries and veins on roentgenograms and to determine if they were differentially involved in different types of heart disease.

ANATOMY

The anatomy of the pulmonary veins, extensively reviewed by Lodge (5) and presented also in standard textbooks of anatomy (2), will be described only briefly. The pulmonary veins return the oxygenated blood from the lungs to the left atrium of the heart. As a rule, two main veins arise from each lung, with a trunk coming from each of the five lobes. The trunks for the right upper and middle lobes may unite before they enter the posterior aspect of the left atrium. Occasionally the three veins on the right side enter the heart separately, or the veins of the middle and lower lobes may unite to form a single trunk. Not infrequently the two left pulmonary veins end in a common opening.

At the root of the lung the superior pulmonary vein lies in front of and below the pulmonary artery; the inferior is situated

[1] From the Department of Radiology, University of California School of Medicine, San Francisco, Calif. Accepted for publication in July 1954.



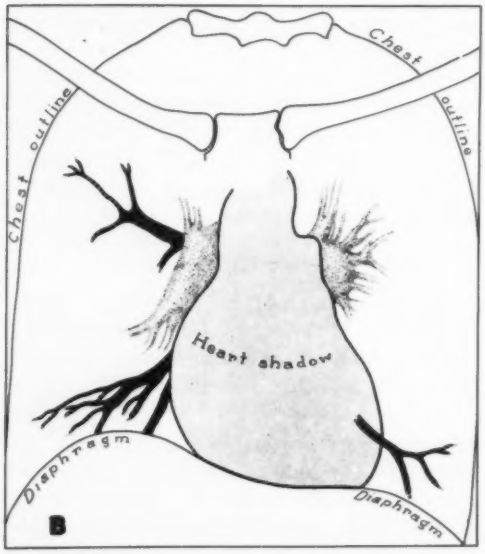


Fig. 1. A. Roentgenogram of a postero-anterior projection of a normal chest. The veins draining the upper and lower lobes on the right side and a single trunk from the left lower lobe are demonstrated.

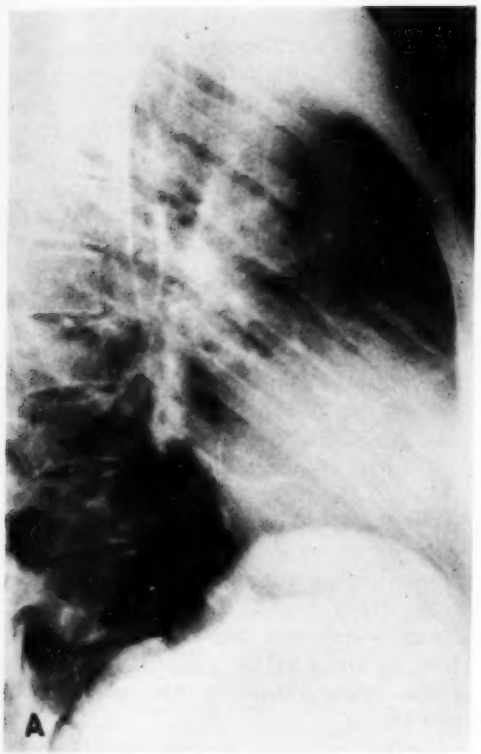
B. Diagram of A. The veins are shown in black and the main portions of the pulmonary arteries are stippled. The terminal portions of the pulmonary veins are obscured by the cardiac shadow.

C. Tomogram of the same patient. The veins from the right upper and lower lobes and the lower lobe on the left side are demonstrated to better advantage by this technic.

at the lowest part of the hilus of the lung and on a plane posterior to the upper vein. The veins arise from a capillary network upon the walls of the air sacs, where they are continuous with the capillary ramifications of the pulmonary artery, and, joining together, form one vessel for each lobule. These vessels unite and form the larger veins which drain the bronchopulmonary segments.

The venous supply of the two lungs is similar, with the veins of the lingular branch of the left upper lobe corresponding to those of the right middle lobe. Consequently, only the veins of the right lung will be described in detail. According to Lodge (6), Herrnheiser has named the four main veins in the upper lobe as the subpleuromediastinal vein, the apical vein, the pectoral vein, and the axillary vein. Descending in a medial direction, they cross the intermediate trunk of the pulmonary artery anteriorly and then unite into one trunk, passing medially and caudally to the left atrium. The two chief veins in the right middle lobe are called the paramediastinal and the costal. There are five main venous trunks in the lower lobe: the apico-horizontal vein, the anterior basal vein, the anterior axillobasal vein, the posterior basal vein, and the posterior axillobasal vein. Proceeding upward and medially, they unite to form the inferior pulmonary vein.

It is not generally appreciated that the veins of both lungs are visible on roentgenograms of the chest. In a recent article on



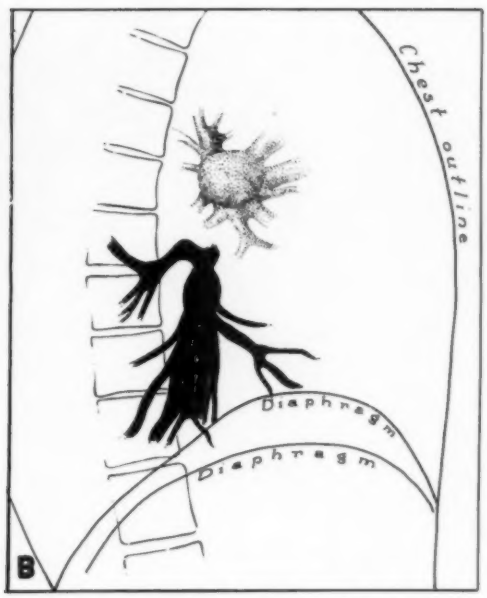
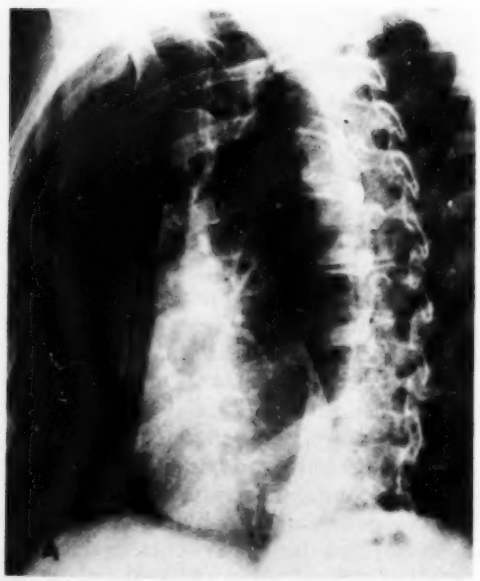


Fig. 2. A. Lateral view of a normal chest. In this projection, veins from the lower lobe can be seen to converge toward the posterior aspect of the left atrium. The veins from the two sides are superimposed. The veins from the upper and anterior portions of the chest are largely obscured by the various shadows of the mediastinum and heart.

B. Diagram of 2A.



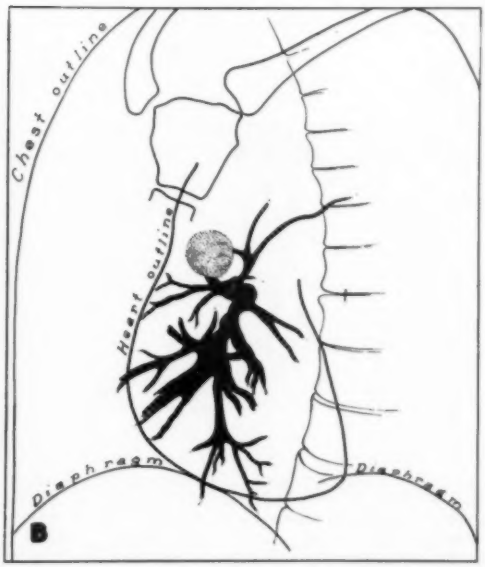
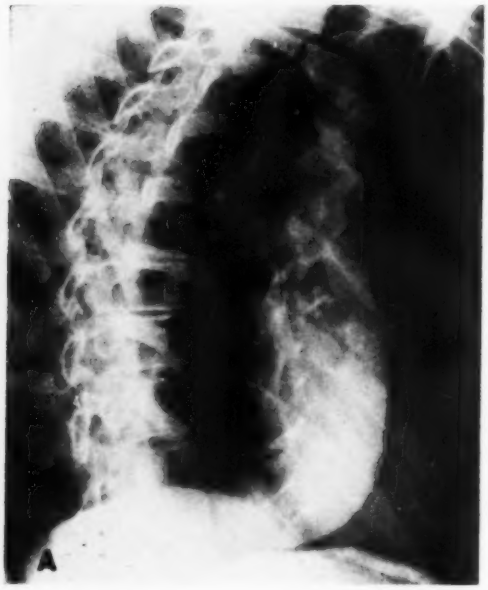


Fig. 3. A. Left anterior oblique projection of a normal chest. The venous tributaries from the right lower and middle lobes converge to form a fairly distinct channel which represents the inferior pulmonary vein, and the branches from the upper lobe can be seen to form a separate vessel which is located above the inferior pulmonary vein. Both of these main veins lie below and somewhat posterior to the main pulmonary artery on the right side. Due to the particular film density used, the veins from the left lung are not visualized. B. Diagram of A.



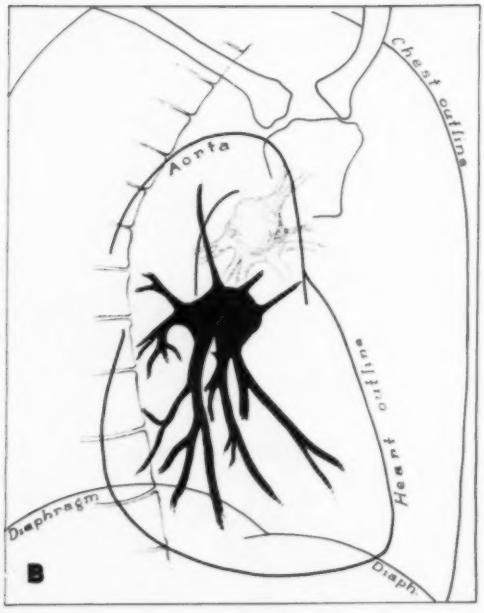


Fig. 4. A. Right anterior oblique projection of a normal chest. The two main pulmonary veins of the left lung are superimposed in this projection so that they appear as a single large vessel. The venous tributaries from the upper and lower lobes can be seen to converge upon these larger veins. The main veins on the left side are present below and somewhat posterior to the main pulmonary artery of the same side.
B. Diagram of 4A.

mitral stenosis, the statement was made that ordinarily the larger retrocardiac pulmonary veins are not roentgenologically definable (4). As a rule, however, these retrocardiac veins do cast visible shadows, particularly in oblique views, and sometimes on the postero-anterior view through the cardiac shadow. Lodge was able to identify many of the veins on a series of 100 normal postero-anterior radiographs of the chest (5). He could distinguish the apical axillary and pectoral veins in the right upper lobe in 7 patients. None of these vessels was identified on the left side, nor were any of the middle lobe or lingular veins seen. In 77 cases the main venous trunk or its branches in the lower lobe were visible on the right side, and in 5 cases on the left side. We have found the veins to be demonstrated on oblique views. In the conventional roentgen examination of the heart, which consists of a postero-anterior, a heavily exposed postero-anterior, both obliques, and a left lateral projection, some of the veins could be identified in all patients.

Figures 1 through 4 demonstrate the normal pulmonary arteries and veins in the different projections. In the postero-anterior films (Fig. 1) the veins of the right lower lobe are most easily seen. By virtue of their course to the left atrium, in which they cross the arteries, they can be separated from the shadows cast by the latter. The right upper lobe vein can sometimes be seen as it passes medially and downward, crossing the intermediate artery. The veins from the upper lobe of the left side are not ordinarily demonstrable in this projection. The mediastinal shadow obscures the medial portions of the veins on both sides.

In the lateral view (Fig. 2) only the veins to the lower lobes can be identified in their course to the left atrium. The veins of both lungs are superimposed and cannot be differentiated from each other.

In the oblique views (Figs. 3 and 4) the main venous trunks of one side appear as oval or circular shadows superimposed upon

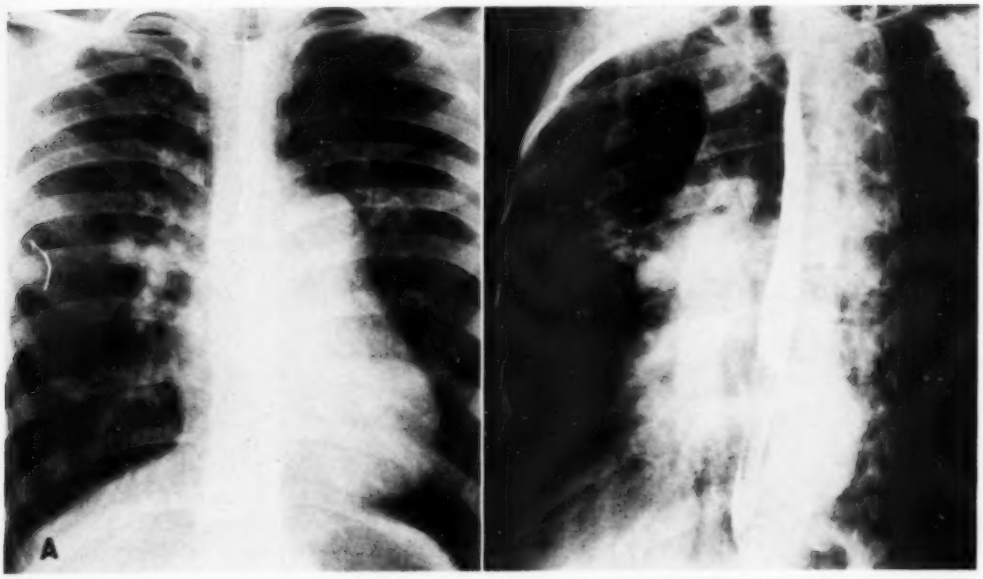
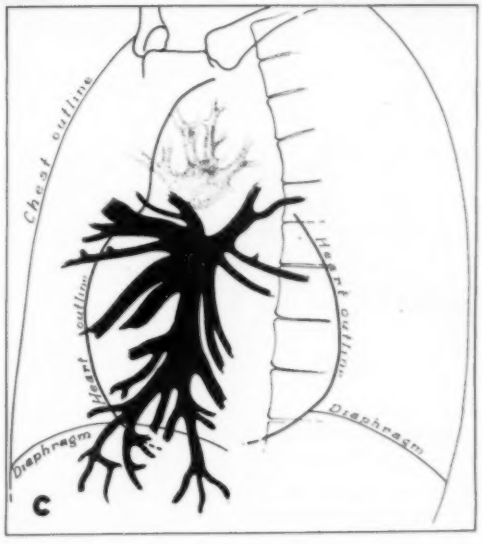


Fig. 5. A and B. Postero-anterior and left anterior oblique projections of a patient who had an aortic pulmonary window which was proved surgically. The main pulmonary artery is markedly dilated; the hilar and parenchymal branches are also increased in size. The pulmonary veins are dilated; this is best seen in the left anterior oblique projection. In the latter projection, two main pulmonary venous trunks of the right lung are superimposed upon each other, but present a shadow separate from that of the pulmonary artery, which lies slightly superior and anterior. C. Diagram of B.



the heart below and slightly dorsal to the pulmonary artery. Occasionally two main trunks, one above the other, may be seen, but their shadows are usually confluent. The smaller venous branches from the entire lung converge toward the main venous trunks like the spokes of a wheel. The upper lobe veins are partly obscured by the pulmonary artery and its branches. In Figure 3 the veins from the right upper lobe can be seen to enter the superior venous trunk, while those from the middle and lower lobe enter the inferior trunk. Ordinarily, the combined shadows of the two main venous trunks on one side have a diameter slightly less than the corresponding pulmonary artery, but this depends to some extent upon the degree of rotation of the patient and the position of the heart in the thorax.

With the usual roentgen technic for cardiac study, only the pulmonary veins seen through the heart shadow are clearly visible; the veins to the opposite lung enter the pericardium at the margin of the cardiac shadow and are overexposed. Thus, in a left anterior-oblique projection the converging segmental and main trunks from the right lung are usually seen superimposed

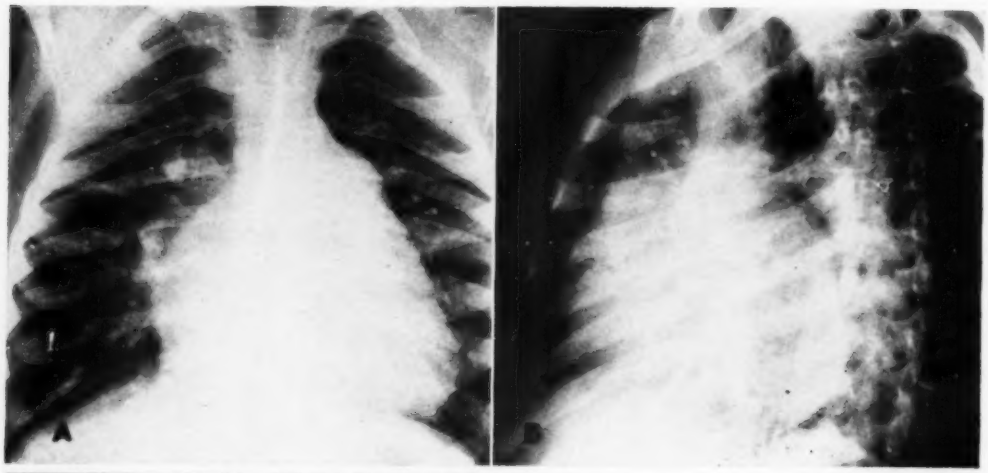


Fig. 6. A and B. Postero-anterior and left anterior oblique projections of the chest in a patient with an interatrial septal defect proved by cardiac catheterization. The main pulmonary artery and its branches can be seen to be considerably dilated. The pulmonary veins arising from the right lower lobe are demonstrated on the postero-anterior view. The enlarged veins are best seen in the left anterior oblique projection, where the branches from the right middle and lower lobes are visible as they converge upon the superimposed main pulmonary veins. C. Diagram of B.

on the heart shadow, whereas those from the left lung are distinguishable with difficulty.

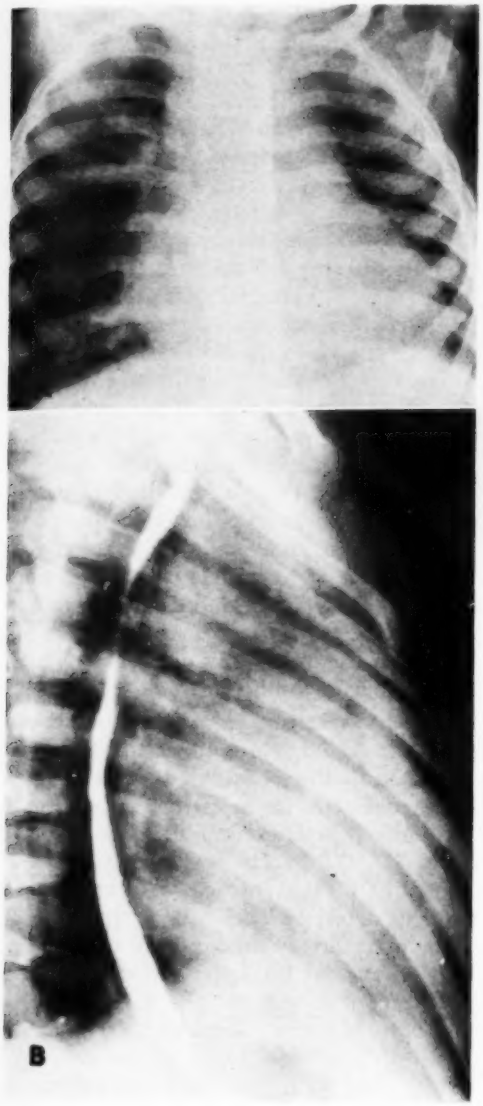
The bronchial arteries usually provide only a small amount of blood to the lungs, and unless these arteries are enlarged, as sometimes occurs in patients with pulmonary stenosis or atresia, they are not visible on roentgenograms. The bronchial veins drain only a small portion of the pulmonary circulation and are of no importance in this discussion.

ROENTGEN INTERPRETATION OF THE VEINS IN CARDIAC ABNORMALITIES

The contour of the heart and size of the arteries and veins give an index of the state of the pulmonary circulatory system. Since much is known about the size and configuration of the heart in health and disease, this paper will be limited to a discussion of the pulmonary vasculature, with emphasis on the veins.

Normally, the main pulmonary arteries, peripheral vessels, and main veins bear a certain relatively constant size relationship to one another. Usually, with accelerated pulmonary blood flow all of the vessels increase in size to accommodate the increased volume of blood, and with decreased flow they all diminish in size. This is true, irrespective of the cause of the altered circulation.

There are some instances, however, in which the pulmonary arteries are large and the peripheral vessels and veins are not correspondingly dilated. This occurs in pulmonic stenosis with post-stenotic dilatation of the pulmonary artery. In this instance the main pulmonary artery is dilated and the hilar branches usually appear



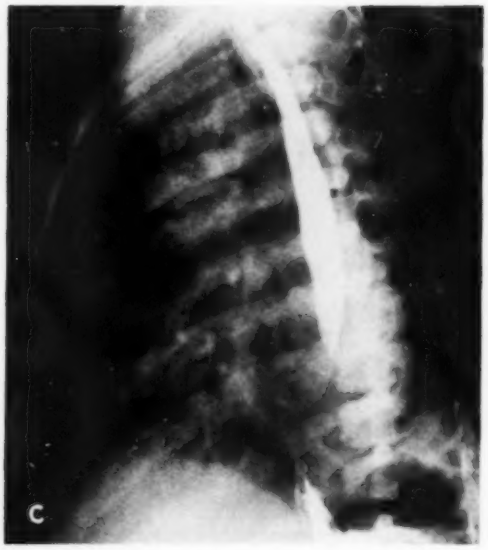


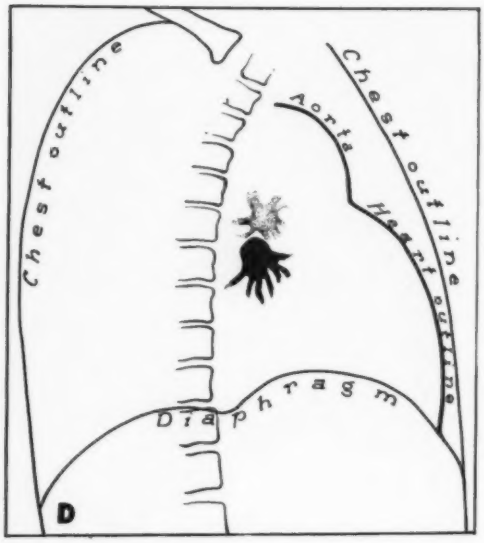
Fig. 7. A, B, C. Postero-anterior, right anterior oblique, and left anterior oblique projections of the chest of a patient with truncus arteriosus. This condition was proved by autopsy, at which time it was noted that there was an absence of a pulmonary artery to the left lung, which received its blood supply from enlarged bronchial vessels. The pulmonary artery to the right lung was considerably increased in size.

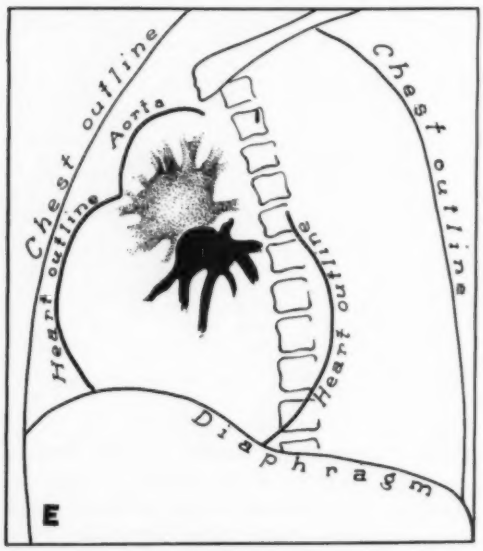
The roentgenogram demonstrates the decreased circulation in the left lung. The arteries in the left lung lack the usual configuration of a pulmonary artery. The pulmonary veins are exceptionally small. In the right lung, as seen on the left anterior oblique projection, the pulmonary artery appears to be increased in size, as do the branches extending into the parenchyma. The right pulmonary veins are also markedly dilated. The two right main venous trunks are superimposed upon each other. The aorta passes to the right of the trachea.

For diagrams of B and C see the following page.

normal, although occasionally increased or decreased in size, in the presence of decreased pulmonary blood flow. The size of the peripheral vessels and main pulmonary veins may then be important in evaluating the status of the pulmonary circulation. Another example of a dissociation between the sizes of the arteries, peripheral vessels, and veins is frequently found in mitral valve disease. Thus it is important that the roentgen appearance of the pulmonary arteries and veins be evaluated separately in order to estimate correctly the volume of pulmonary blood flow. Other factors, such as reflex vasoconstriction and thickening of the vessel walls, may alter the size of the vessels, but these considerations are beyond the scope of this discussion.

Increase in Size of the Pulmonary Veins: The pulmonary veins are larger than normal in those cases where there is an increase in the volume of blood flowing through the lungs. This situation exists in the presence of intracardiac shunts in which the blood flow is from the left side to the right side of the heart, and in cases of





Figs. 7. D and E. Diagrams of 7B and 7C (preceding page), respectively.

patent ductus arteriosus and aortic pulmonary window (Figs. 5 and 6). The size of the vessels depends upon the degree of the shunt. A survey of 100 cases of proved patent ductus revealed that the enlargement of the pulmonary veins was sufficient to be seen on roentgenograms in 71 per cent of the cases (3).

A recent case studied at the University of California Hospital demonstrates the importance of evaluating the size of the pulmonary veins. The patient, a fourteen-year-old male, had a basal systolic murmur known to have been present for eight years. The clinical diagnosis was pulmonary stenosis. The roentgen appearance was thought to be consistent with the clinical diagnosis, except for the presence of large pulmonary veins, a finding which, in our experience, is paradoxic for pure pulmonic stenosis. In uncomplicated pulmonary stenosis the veins should be small, or possibly normal in size. Cardiac catheterization studies, which showed the pulmonary artery pressure to be lower and the oxygen saturation higher than in the right ventricle, revealed that the patient had a patent ductus arteriosus in addition to pulmonic stenosis. An anomalous pulmonary vein entering the right auricle was also demonstrated. The patent ductus arteriosus and anomalous venous return to the heart account for the increased pulmonary circulation and large pulmonary veins.

Another patient, a nineteen-month-old cyanotic child, presented the unusual roentgen findings of dilated pulmonary arteries and veins in the right lung and small pulmonary arteries and veins in the left (Fig. 7). The aorta was seen passing to the right of the trachea. At autopsy, a truncus arteriosus was found, with a right pulmonary artery arising from the truncus and absence of the left pulmonary artery. The blood supply to the left lung was through bronchial arteries. In unusual cases of this type, regional correlation of artery and vein size may be helpful in clarifying the nature of the congenital malformation.

Decrease in Size of Pulmonary Veins: It is often difficult to detect the presence of decreased arterial circulation of the lungs in patients with congenital pulmonic valvular or infundibular stenosis. The diagnosis of decreased pulmonic circulation, irrespective of its cause, can be made with much greater assurance if the main pulmonary veins are also smaller than normal. In instances where the pulmonary circula-

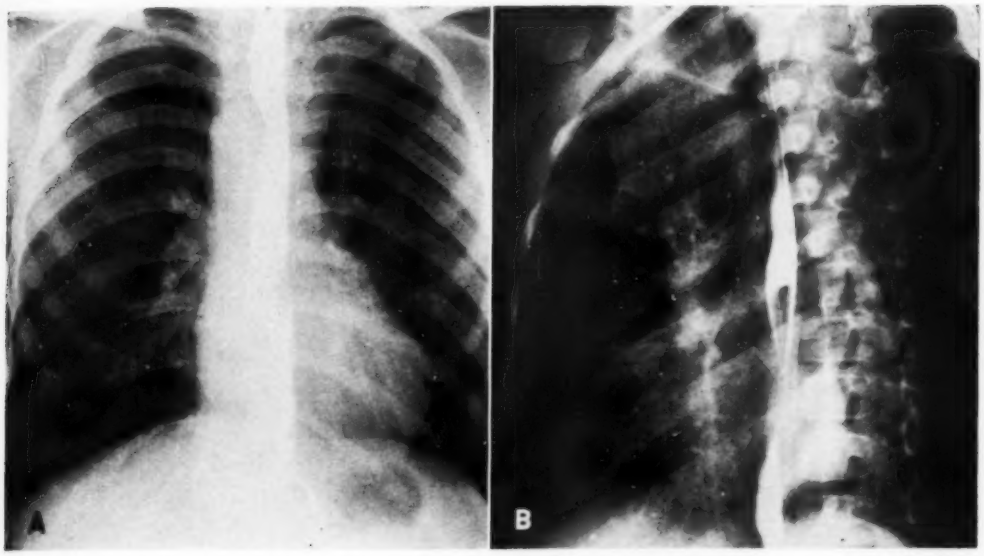
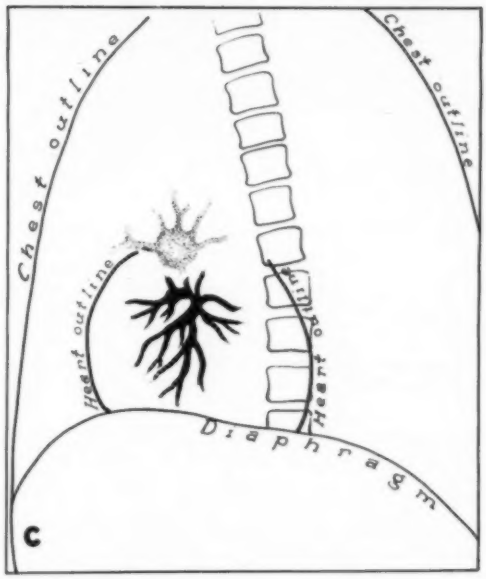


Fig. 8. A and B. Postero-anterior and left anterior-oblique projections of a patient with a surgically proved tetralogy of Fallot. The main pulmonary arteries and hilar shadows appear somewhat small and the more peripheral arteries are greatly diminished in caliber. The pulmonary veins are best demonstrated on the left anterior-oblique projection. The tributaries arising from the right lower and middle lobes are visible and appear to be considerably diminished in caliber. The two main pulmonary veins on the right side are also demonstrated and are very small. A right-sided aortic arch and descending aorta are present. C. Diagram of B.



tion is only slightly impaired, the veins may appear normal on the roentgenograms. However, with a dilated pulmonary artery, the presence of even a normal-sized vein should rule out the possibility of an increase in circulation due to intracardiac shunt and lead to the correct diagnosis of decreased pulmonary circulation. In the present study, small pulmonary veins have been demonstrated in patients with pulmonic stenosis, tetralogy of Fallot, tricuspid atresia, and truncus arteriosus (Fig. 8).

In a case of proved massive thrombosis of the main pulmonary artery and its hilar branches, the main pulmonary arteries were very large, the smaller arteries markedly narrowed, and the veins were exceedingly small as a result of decreased pulmonary circulation (Fig. 9).

Size of Pulmonary Veins in Acquired Mitral Valvular Disease: The appearance of the pulmonary veins in patients with mitral disease is somewhat surprising if one believes that the dilatation of the main branches of the pulmonary arteries is a direct response to increased pressure produced by obstruction of flow through the mitral valve. If this were true, and if increased pressure were transmitted from the

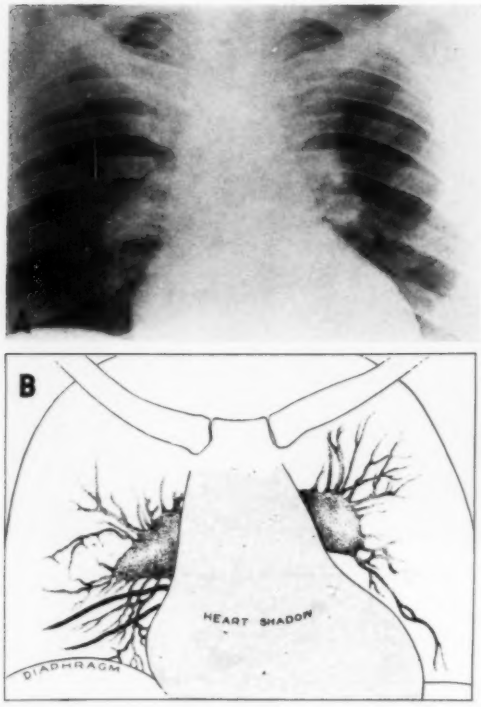


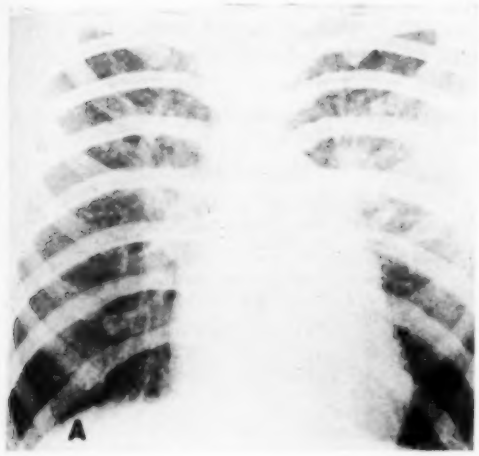
Fig. 9. A and C. Postero-anterior and left lateral projections of a patient with a massive thrombosis of the main pulmonary artery and its major branches, proved at autopsy.

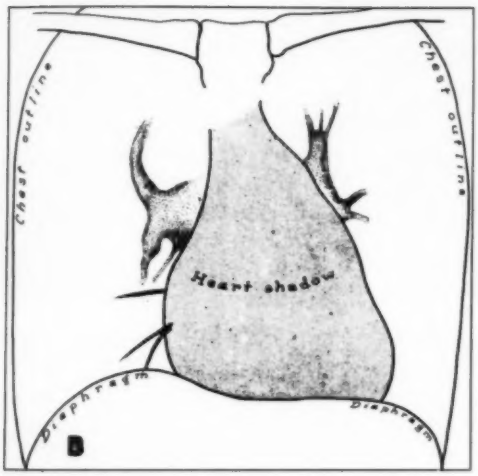
The shadows representing the main pulmonary artery and hilar branches are markedly dilated. These arteries become narrowed very abruptly, and the vessels in the peripheral lung fields are diminished in caliber. There are only two branches of the pulmonary veins visible in the postero-anterior projection; these are seen near the right lower border of the heart. On the lateral view, the veins from both sides are superimposed and appear narrow. B. Diagram of A.

left atrium through the pulmonary veins to the pulmonary arteries, it would be expected that the pulmonary veins would be very large. Actually in most cases they appear to be normal, although there is occasionally a slight increase or decrease in size (Fig. 10). This can be explained on the basis of the work of Steiner and Goodwin (7) who, through the use of cardiac catheterization studies, found some direct correlation between the extent of narrowing of the smaller pulmonary arteries and the increase of pressure in the main pulmonary arteries. Angiocardiography disclosed a correlation between the size of the pulmonary artery and the pulmonary artery pressure. This was interpreted as being due either to a vasoconstriction of the peripheral pulmonary arteries or to organic arterial narrowing which would serve to prevent transmission of the high arterial pressure to the pulmonary veins and thus account for their relatively small size. This is also true of primary pulmonary hypertension from other causes.

De Bettencourt, Saldanha and Fragoso (1) made tomographic studies of the pulmonary veins in 50 cases of mitral disease and found that patients with heightened pulmonary capillary pressure showed prominent pulmonary arteries with small pulmonary veins. This was assumed to be due to increased venous tonicity. In the majority of the patients with sinus rhythm, the veins were large. In the presence of auricular fibrillation they were usually small. In a series of 14 proved cases of mitral stenosis and mitral stenosis and insufficiency, we were unable to demonstrate a correlation between the vein size, as determined roentgenographically or at surgery, and auricular fibrillation or sinus rhythm.

At the University of California Hospital,





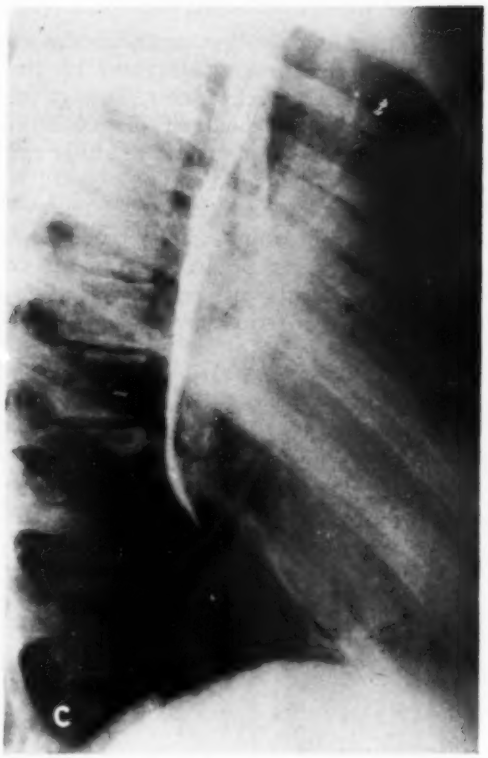


Fig. 10. A and C. Postero-anterior and left lateral projections of the chest in a patient with surgically proved mitral stenosis.

The main pulmonary artery and hilar branches are dilated. These become narrowed in the peripheral lung fields. The veins arising from the right lower lobe are visible in the postero-anterior projection. In the lateral view the venous tributaries appear to be smaller than usual. They can be seen to converge upon an enlarged left atrium. B. Diagram of A.

in a review of the operative reports of several proved cases of mitral stenosis and mitral insufficiency, it was noted that the surgeon occasionally described large pulmonary veins, even though the roentgenograms showed the veins to be normal, or smaller than normal, in size. In performing a mitral valvulotomy, the only visible part of the pulmonary vein is a short segment lying within the pericardium. It may be that the part of the vein immediately adjacent to the left auricle participates in the distention or stretching of this chamber of the heart and that this distention is not shared by the smaller veins lying within the lungs. The surgeon is accustomed to seeing small pulmonary veins in cases of pulmonary stenosis, and his judgment may be influenced to some extent by a comparison of these veins with those in mitral disease. These considerations, together with the fact that the surgeon is examining the veins of an anesthetized patient in the horizontal position, suggest that the surgical impression may correlate poorly with the actual status of the extrapericardial pulmonary veins in an ambulatory subject. The roentgen method has the advantage that it does not in itself alter the physiological or pathological processes under investigation.

SUMMARY AND CONCLUSIONS

1. The pulmonary veins can be demonstrated in plain roentgenograms of the chest. An assessment of their size may aid materially in the roentgen diagnosis of cardiac or great vessel disease of either the congenital or the acquired type.

2. The size of the veins correlates well with the amount of pulmonary blood flow.

3. Large veins occurred in cases of intracardiac shunts with left to right flow, patent ductus arteriosus, and aortic pulmonary window.

4. In the present study small pulmonary veins have been found in pulmonic valvular stenosis, tetralogy of Fallot, and pulmonary artery thrombosis.

5. Of particular interest was the observation that in mitral stenosis and in mitral stenosis plus mitral insufficiency the pulmonary veins are usually of normal size, rather than enlarged. Occasionally they may be smaller than normal, even though the right ventricle, pulmonary artery, and left atrium are definitely enlarged. This may be explained on the basis of constriction of the peripheral vessels and/or larger veins.

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SUMARIO

El Aspecto Roentgenológico de las Venas Pulmonares en las Enfermedades del Corazón

Tratóse de justipreciar por separado el aspecto roentgenográfico de las arterias y las venas pulmonares y de determinar si intervienen en forma diversa en distintas formas de cardiopatías. Este trabajo considera en particular las venas.

Las venas pulmonares pueden observarse en radiografías corrientes del tórax. Un cálculo de su tamaño puede ayudar decididamente en el diagnóstico roentgenológico de enfermedad del corazón o de los grandes vasos, de forma ya congénita o adquirida. El tamaño de las venas se correlaciona bien con la cantidad de sangre que cruza el pulmón. Observáronse venas agrandadas en casos de desviaciones intracardíacas con circulación de derecha a izquierda, conducto arterioso permeable y comunicación aórtico-pulmonar.

En el estudio actual, observáronse venas pulmonares reducidas en la estenosis de la válvula pulmonar, la tetralogía de Fallot y la trombosis de la arteria pulmonar. De interés en particular fué la observación de que, en la estenosis mitral y en la estenosis mitral unida a insuficiencia mitral, las venas pulmonares suelen ser de tamaño normal, en vez de estar hipertrofiadas. De vez en cuando, pueden ser más pequeñas de lo normal, aunque estén hipertrofiados el ventrículo derecho, la arteria pulmonar y la aurícula izquierda. Esto puede explicarse a base de la constricción de los vasos periféricos y/o las venas mayores.

Roentgen Aspects of Pleural Mesothelioma[1]

NATHANIEL FINBY, M.D., and ISRAEL STEINBERG, M.D.

MESOTHELIOMA of the pleura is a neoplastic disease which develops from the lining cells of the pleura. Its origin has long been in dispute, but the recent tissue culture studies of Stout and Murray Clinical differentiation is important because of the surgical and prognostic implications. Twelve cases of mesothelioma, 5 of the localized and 7 of the diffuse type are herein reported.

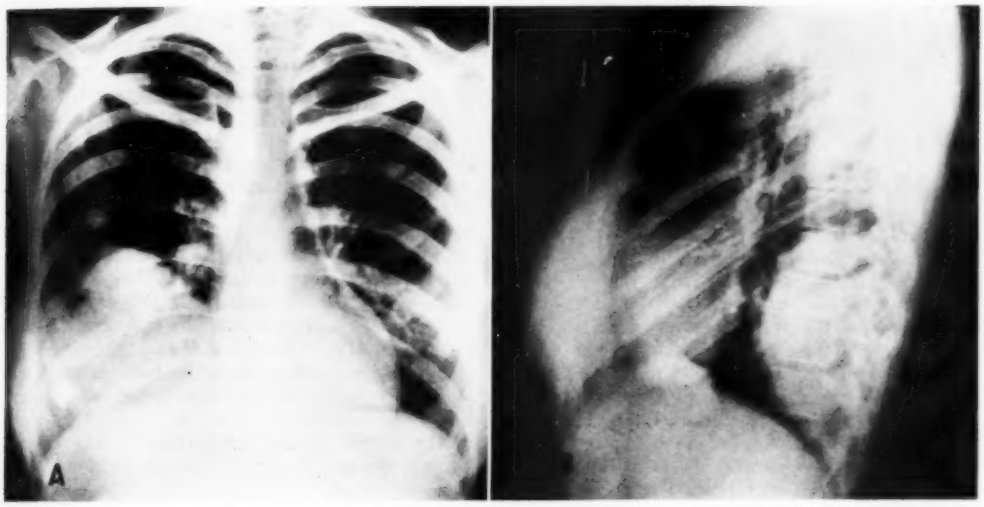

Fig. 1. Case I. A. Frontal chest film showing a large mass obscuring the lower right lung field.
B. Lateral view showing posterior position of the mass, with rounded anterior margin.

(1), confirmed by Sano, Weiss, and Gault (2), have established the mesothelial character of the tumor.

The controversy regarding mesothelioma has led to more than thirty designations (3), due to the fact that mesothelial cells may assume different histologic forms. The term endothelioma has frequently been used (4) because it was believed that the tumor originated from endothelial structures. Robertson (5) prefers the term pleural sarcoma, while Saccone and Coblenz (6), in order to avoid the controversy of cell origin, called the condition a pleuroma.

Two groups of mesothelioma have been recognized, the localized and the diffuse.

CASE REPORTS

Localized Pleural Mesothelioma

CASE I: A 24-year-old white woman was admitted on July 24, 1942. In December 1941, a routine chest film revealed a "shadow" in the right lung. The patient remained asymptomatic until, prior to admission, a dry cough developed, with dull pain in the right lower chest posteriorly. The pain was pleuritic in type and lasted three weeks. There was no weight loss, hemoptysis, or fever. A repeat chest film (Fig. 1) showed increase in size of the mass, and surgery was advised. Physical examination revealed dullness and absence of breath sounds beneath the level of the right fifth rib posteriorly. The roentgenogram disclosed a localized area of increased density in the posterior portion of the right lower chest.

On thoracotomy the right lower lobe was found to be almost completely replaced by a large firm globular

[1] From the Departments of Radiology and Medicine of The New York Hospital-Cornell Medical Center. Aided by a grant from the Mallinckrodt Chemical Works. Accepted for publication in August 1954.

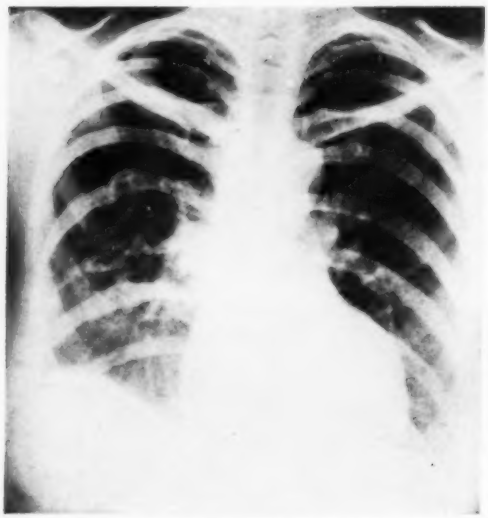

Fig. 2. Case I. Chest film twelve years after thoracotomy. Postoperative changes but no evidence of neoplasm.

mass, and a lobectomy was performed. There were no enlarged lymph nodes in the mediastinum. Pathologic examination revealed a large ovoid tumor weighing 360 gm. and measuring 11 × 10 × 5 cm. The mass was sharply circumscribed but did not possess a distinct capsule. Histologic examination showed papillary processes consisting of well defined flat cells which resembled endothelial cells and sheets of large polyhedral or ovoid cells. In some places the neoplasm replaced the alveoli and, although mitotic figures were not numerous, the variation in cell morphology suggested malignancy. Follow-up examination twelve years later showed a well patient with no evidence of disease (Fig. 2).

CASE II: A 71-year-old white man was admitted on June 2, 1950, with pain in the right anterior chest wall of one month duration. He had experienced a productive cough, and the sputum was occasionally blood-streaked. Physical examination was unremarkable. The lungs were clear. The chest x-ray examination revealed a large circumscribed rounded density adjacent to the right heart border and multiple right lower rib fractures (Fig. 3). The bronchoscopic findings were normal. Angiocardiography demonstrated displacement of the right atrium by the tumor (Fig. 4). Papanicolaou study of the sputum was negative for malignant cells. Another roentgenogram, two weeks later, showed increase in size of the tumor.

Thoracotomy revealed a firm mass involving the right lower and middle lobes. It was adherent to the pericardium and infiltrated the superior pulmonary vein, necessitating a pneumonectomy. Pathologic study showed the middle lobe to be completely replaced by a friable, gray-yellow tumor which also infiltrated the upper and lower lobes. The tumor measured 9 × 10 × 2 cm. Ulceration of the pleural surface was present. The central zone of the tumor appeared to be necrotic. His-

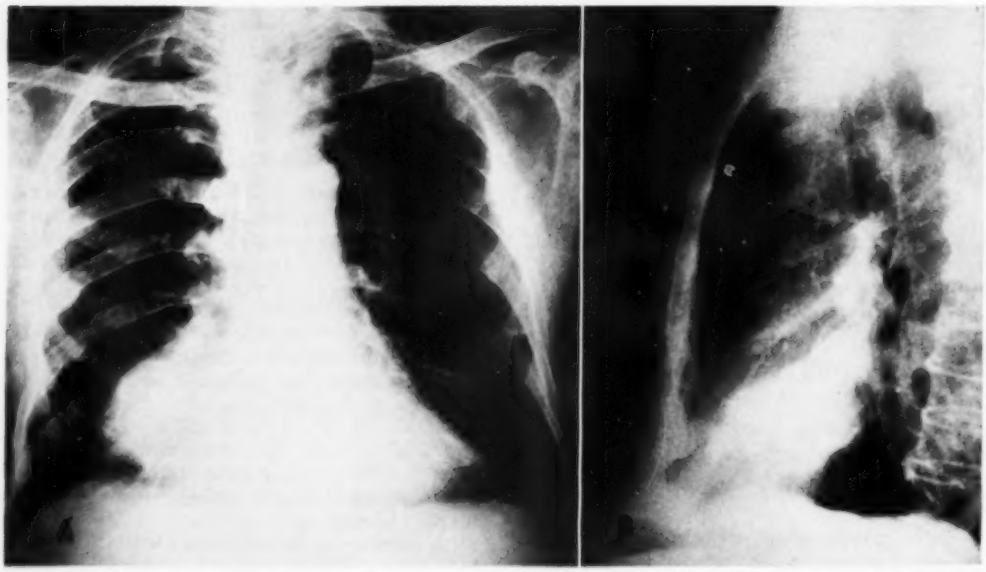

Fig. 3. Case II. A. Frontal chest film showing rounded density adjacent to right heart border. There are healing fractures of the right seventh, eighth and ninth ribs.
B. Lateral view shows the circumscribed mass in the region of the right middle lobe.

tologic study showed the predominant cellular element to be an elongated spindle-shaped structure with abundant basilar cytoplasm. Mitotic figures were abundant. The patient did well postoperatively but died suddenly fifteen days later. An autopsy was not secured.

CASE III: A 28-year-old white woman was seen on Jan. 8, 1945, after a routine chest roentgenogram showed a well defined rounded right superior mediastinal mass (Fig. 5). The patient had noted only slight non-productive cough. A month later, the mass appeared larger and roentgen therapy was begun. A total of 1,500 r in air was delivered in a period of one week with 250-kv technic. Treatment was discontinued because of onset of chest pain, chills, and fever.

Physical examination revealed no abnormal findings. Angiocardiography (Fig. 6) showed marked displacement of the superior vena cava to the right and an unsuspected pericardial effusion. A thoracotomy was done on March 13, and an encapsulated, lobulated, yellowish mass about 6 cm. in greatest diameter was found. The superior vena cava was widely adherent to the tumor and the mass was only partially excised. There were no enlarged mediastinal or hilar lymph nodes, and the pericardial effusion was drained. Histologic examination of the tumor showed a malignant mesothelioma with many spindle cells.

The postoperative course was uneventful and on April 2 the chest roentgenogram (Fig. 7A) showed no evidence of disease of the mediastinum, pericardium or lungs. Six months later the patient was worse and the chest roentgenogram (Fig. 7B) disclosed a large recurrent mediastinal tumor and pulmonary metastases. Death occurred on Jan. 2, 1946.

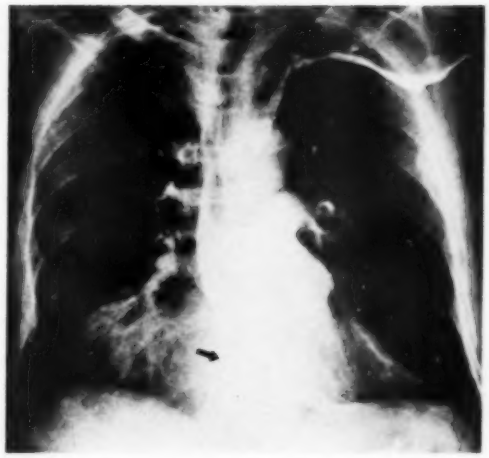

Fig. 4. Case II. Angiocardiogram, frontal view (right heart filling). Smooth indentation of the right atrium (arrow) by adjacent rounded mass. Note the normal appearance of the branches of the right pulmonary artery.

CASE IV: A 40-year-old woman was admitted on Oct. 26, 1942, because of a bout of fever, upper respiratory infection, and joint pains of four weeks duration. The fingers, knees, and feet were painful, swollen, and tender, and the fingers and toes were clubbed. The chest roentgenogram (Fig. 8)

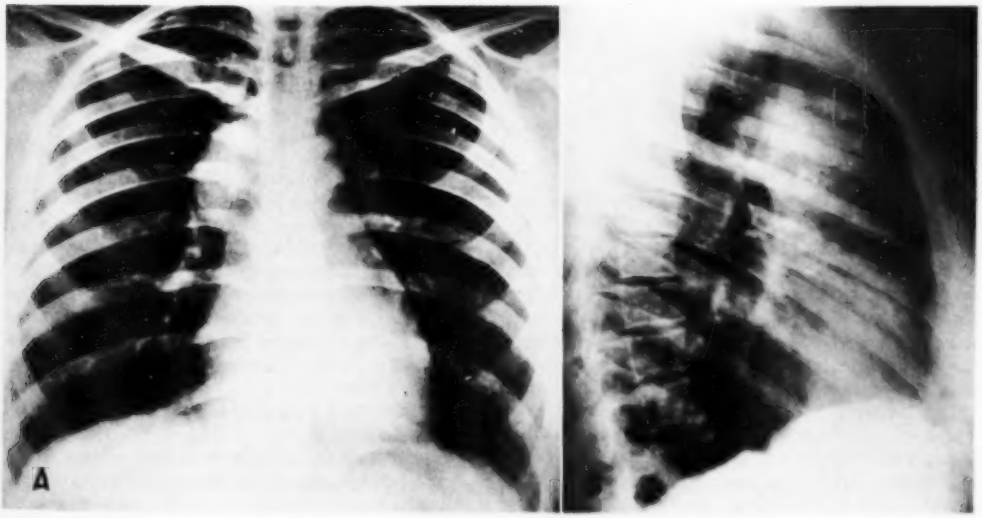

Fig. 5. Case III. A. Frontal chest film showing a right superior mediastinal mass with circumscribed rounded lateral border.
B. Right lateral view showing the rounded mass adjacent to the ascending aorta.

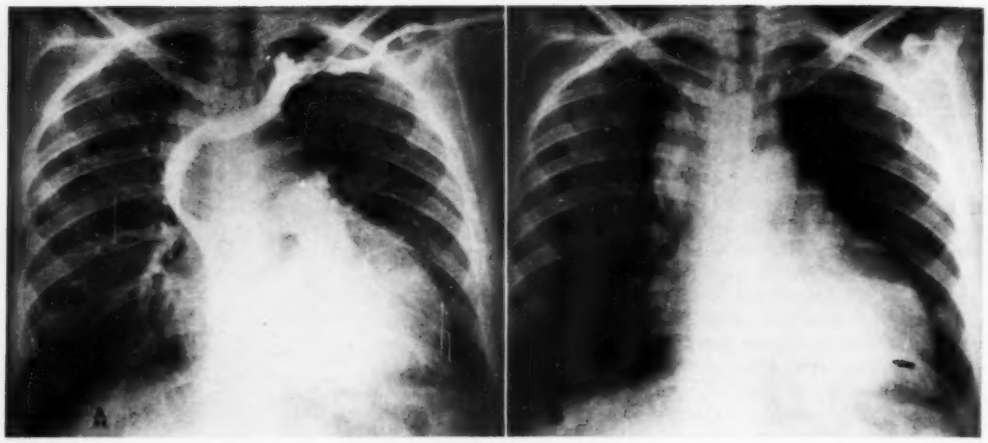

Fig. 6. Case III. A. Angiocardiogram (right heart filling) showing marked displacement of the superior vena cava and right pulmonary artery. The right cardiac chambers appear normal but a pericardial effusion is present.

B. Angiocardiogram (left heart filling) showing opacification of normal left ventricle and aorta. Note pericardial effusion. Arrow points to lateral margin of left ventricular chamber.

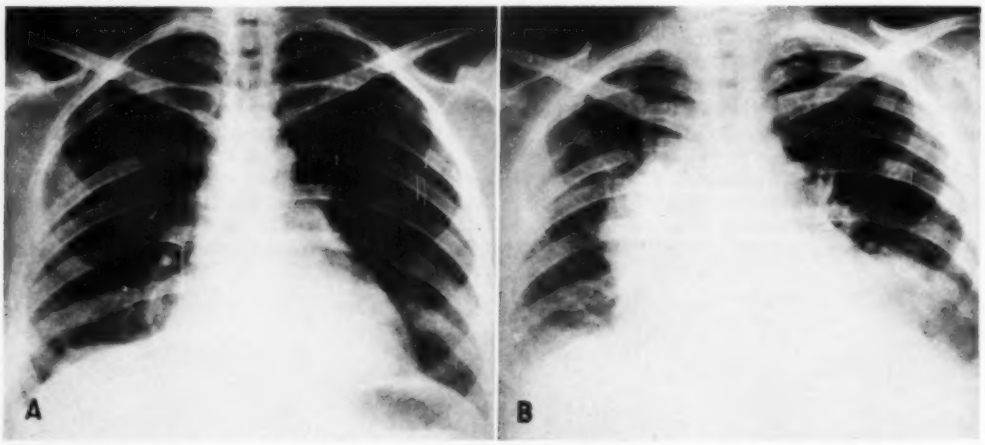

Fig. 7. Case III. A. Chest film three weeks postoperatively, showing no evidence of neoplasm.
B. Chest film six months postoperatively disclosing large mediastinal and pulmonary metastases.

showed a well demarcated density in the lower right thoracic cavity. Bronchoscopy revealed narrowing of the right middle lobe bronchus, and a biopsy was negative. Thoracentesis yielded small amounts of thin yellow sterile fluid. Thoracotomy was done, and a large ovoid tumor mass, $15 \times 8 \times 9$ cm., was removed from the right pleural cavity. It was well encapsulated and stony hard. Microscopic study revealed the tumor to be composed of loose cellular fibrous tissue without evidence of malignancy. The postoperative course was uneventful and the patient was well eight years later.

CASE V: A 50-year-old chambermaid was admitted because of intermittent pain in the left chest of one year duration. Two months before admission she noted occasional swelling of feet and ankles associated with pain and aching of both legs and stiffness of the knees. Examination disclosed dullness and decreased breath sounds in the left upper lung field. There was in addition brawny edema of both ankles. The chest roentgenogram (Fig. 9) showed a large mass in the lateral portion of the left chest.

Thoracotomy was performed, and a large tumor occupying approximately three-fourths of the left pleural space was found, extending along the lateral border of the left hemithorax. The surface of the tumor was smooth and it was attached only to the lateral portions of the upper and lower lobes

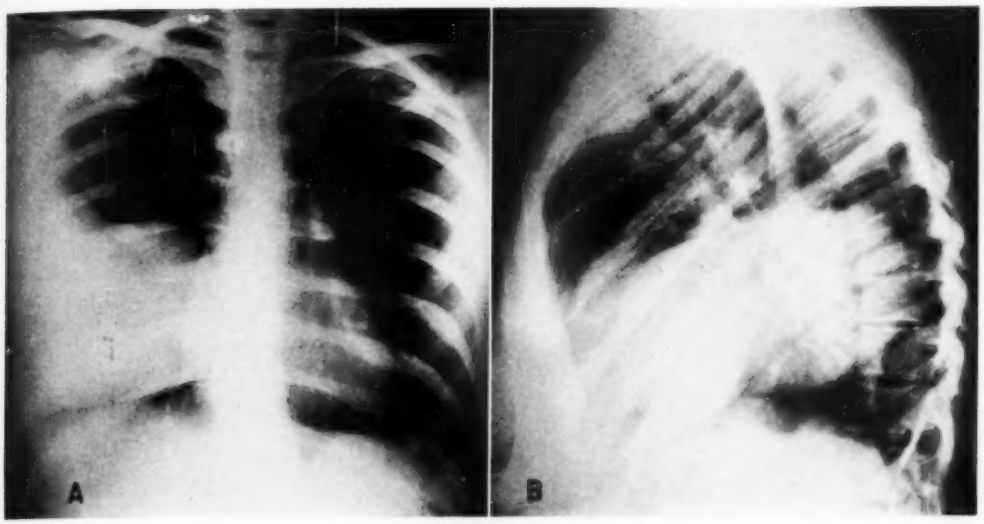

Fig. 8. Case IV. A. Frontal chest film showing large mass in right lower lung field. B. Lateral view revealing circumscribed ovoid mass without pleural effusion.

and to a small area of the parietal pleura in the mid-axillary line, at the level of the fifth rib. The tumor mass and left lung were removed. Pathologic study revealed a fibroid tumor of benign character. The patient was seen seven years after operation with no evidence of recurrence.

Diffuse Pleural Mesothelioma

CASE VI: A 61-year-old white man was admitted on Jan. 15, 1953, complaining of cough, weight loss, and right chest pain. The patient had felt well until two months prior to admission, when a productive cough developed, with sticking pain in the lower right chest. Weakness, fever, and exertional dyspnea followed. On examination, impaired breath sounds and dullness were present over the lower two-thirds of the right chest. A chest roentgenogram revealed a right pleural effusion extending to the mid-thorax (Fig. 10A). An overpenetrated film showed pleural thickening to the apex (Fig. 10B). Bronchoscopy disclosed a narrowed right lower lobe bronchus, and biopsy was negative. Paracentesis yielded 1,250 c.c. of serosanguineous fluid. Papanicolaou studies of the pleural fluid and bronchial washings were negative for tumor cells. Sputum studies showed no acid-fast bacilli.

Air was instilled after the removal of 1,250 c.c. of fluid from the right chest. Figure 11 shows selective collapse of the lobes of the right lung. Thickening of the visceral pleura is particularly evident in the more collapsed middle and lower lobes. The lateral film (Fig. 11B) shows the complete envelopment of the lung by thickened visceral pleura.

At operation the parietal pleura was found to be

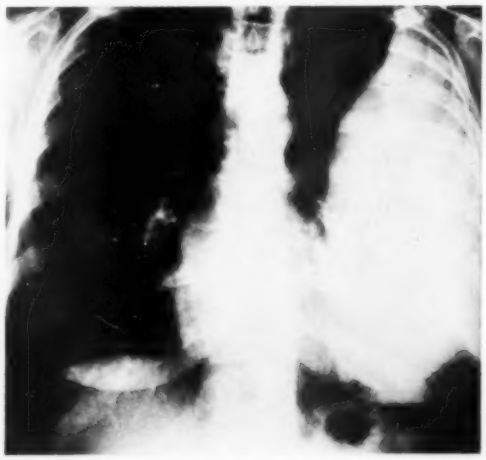

Fig. 9. Case V. Frontal chest film showing large mass in lateral portion of left chest.

thickened from 5 to 10 mm. throughout its extent. The right lung was collapsed and enveloped by a thick layer of yellow-white visceral pleura. This could be stripped from the lung with ease, but complete removal of the neoplasm was not attempted. Biopsies were taken, and the pathologic diagnosis was pleural mesothelioma.

Postoperatively, 75 millicuries of radioactive gold (Au^{198}) was instilled into the right hemithorax. In addition, radiotherapy (1,000 kv) was instituted on March 26 and completed July 6, 1953, with a calculated tumor dose of 3,840 r to the entire right thorax. When last seen, Aug. 11, 1953, the patient

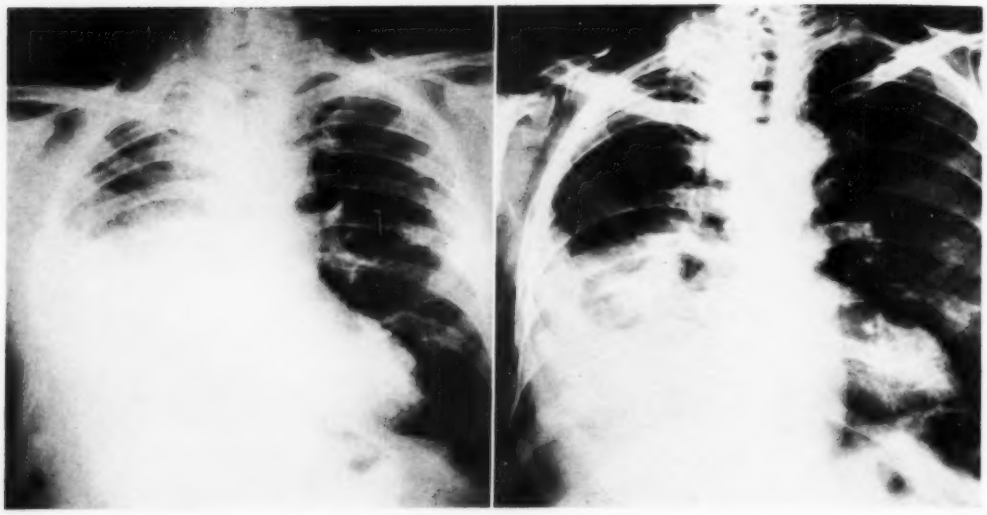

Fig. 10. Case VI. A. Frontal chest film revealing right pleural effusion without mediastinal shift.
B. Overpenetrated film showing pleural density extending along lateral chest wall to apex.

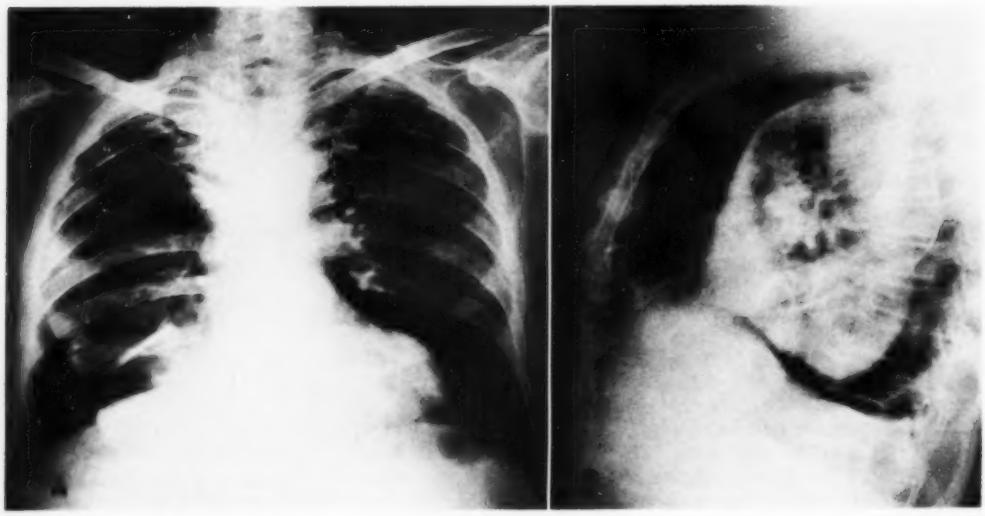

Fig. 11. Case VI. A. Frontal chest film showing right pneumothorax.
B. Lateral view showing thickened pleura, particularly along anterior chest wall and about collapsed lung.

was emaciated, complained of weakness and anorexia, and appeared near death.

CASE VII: A 61-year-old white man was admitted on March 20, 1947. Three months before admission he had experienced pleuritic pain in the right chest posteriorly. Physical examination revealed slight fever and clubbing of the fingers. There were a friction rub and signs of fluid in the right chest. The chest roentgenogram (Fig. 12A) showed the right lower lung field to be obscured by a homogeneous shadow with a curved lateral border. There was also an area of increased density with a sharp border occupying the medial third of the right lung field. The lateral view (Fig. 12B) showed thickening of the pleura (arrow). Thoracentesis yielded 50 c.c. of serosanguineous fluid which on pathologic examination showed no evidence of neoplasm. Bronchoscopic examination revealed extrinsic pressure on the major bronchi. Papa-

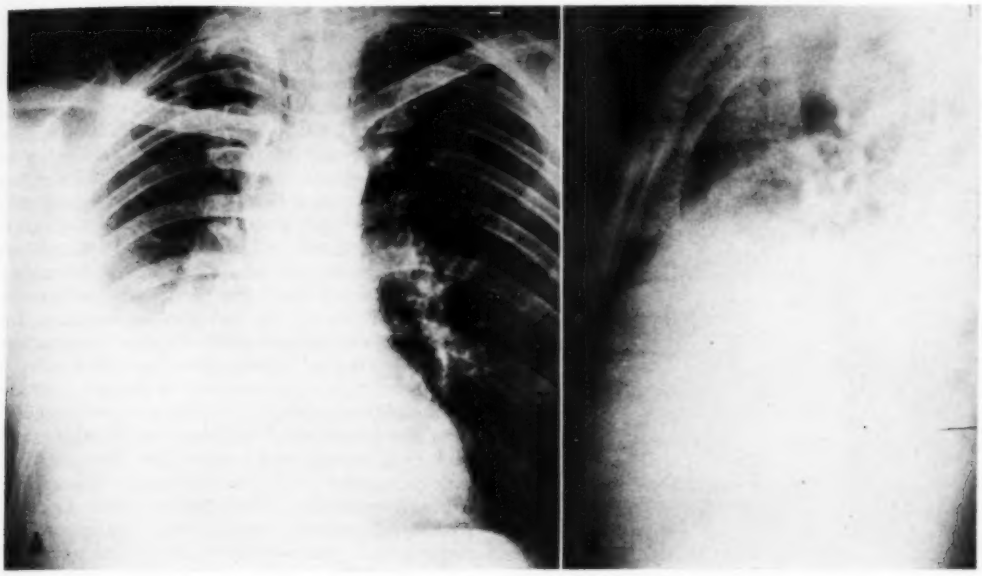

Fig. 12. Case VII. A. Frontal chest film showing a large right pleural effusion. A pleural density is present in the medial third of the right lung field.
B. Lateral view clearly demonstrating the pleural thickening (arrow) and pleural effusion.

nicolaou study of the bronchial washing was negative for tumor cells. Bronchographic study showed incomplete filling of all the branches of the right lower lung bronchus. A chest film obtained after instillation of 300 c.c. of air showed several air-fluid levels but no abnormal nodular masses.

Thoracotomy on the right side showed the parietal pleura to be firm and several millimeters in thickness. The visceral pleura was also thickened and appeared to constrict the partially collapsed middle and lower lobes. Several pockets containing serogelatinous fluid were present in the lower half of the right pleural cavity. In contrast, the upper lobe of the right lung was fully expanded, although the visceral and parietal pleurae were adherent. Partial decortication of the right lung was performed, and some re-expansion of the right middle and lower lobes resulted. Pathologic examination revealed a papillary mesothelioma of the pleura.

X-ray therapy (250 kv) was instituted and a total of 1,400 r in air was given to each of seven portals from May 12 to June 16, 1947. The patient's condition worsened and he died fifteen days later. No autopsy was secured.

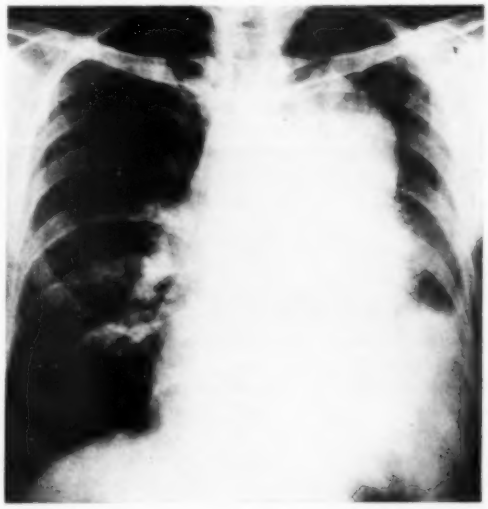

Fig. 13. Case VIII. Frontal chest film showing a left pleural effusion and a large lobulated mass adjacent to the mediastinum.

CASE VIII: A 54-year-old white architect was admitted on Aug. 11, 1952, because of left pleuritic chest pain of three weeks duration. Mild fever and generalized aching of the joints were also present. Examination revealed also mild cyanosis and dullness and decreased breath sounds in the left chest. The chest film (Fig. 13) showed a left pleural effusion with a large lobular mass adjacent to the left mediastinum. Thoracentesis yielded 650 c.c. of serosanguineous fluid, which was sterile and contained no tumor cells. Angiocardiography (Fig. 14) demonstrated a large mass compressing and displacing the main stem and left pulmonary artery.

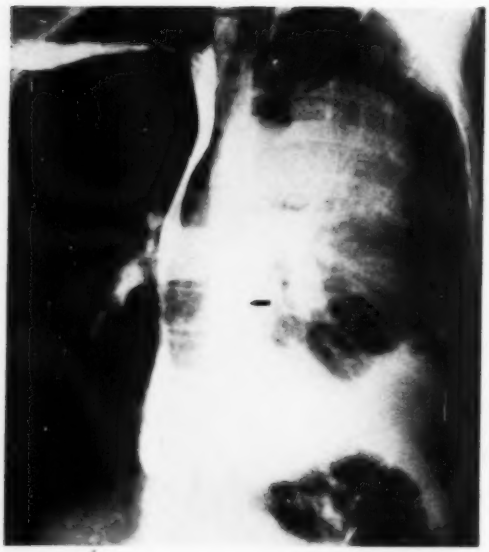

Fig. 14. Case VIII. Angiocardiogram (right heart filling) demonstrating compression and displacement of the pulmonary artery (arrow) and left main branch by a large mass.

Bronchoscopic examination disclosed an extrinsic mass compressing the trachea and left upper lobe bronchus. The tumor was believed to be nonresectable.

X-ray therapy (250 kv) to the mediastinum and left lung was instituted on Sept. 16, 1952, through two anterior and two posterior portals. Between that date and Oct. 14 the patient received a total of 3,000 r in air to each of the two anterior portals and 3,200 r in air to the posterior portals. A subsequent chest film revealed considerable improvement, with marked reduction in the size of the mass, and the patient appeared better and gained 10 pounds in weight. Within a month, however, the chest pain and dyspnea recurred; emaciation, cyanosis, and weakness ensued. A chest examination revealed recurrence of the mass and bilateral pleural effusion. Despite further thoracenteses, death ensued on Dec. 9, 1952.

At autopsy the mediastinum was found to be displaced to the right by a large mass which was continuous with the left lung. The pleural space on the left was completely obliterated by a sheet of white firm tumor tissue containing a few areas of hemorrhage with extension into the lung parenchyma. The tumor was composed of sheets of large polyhedral cells with abundant eosinophilic cytoplasm. Metastases were found in the adrenal and in the hilar lymph nodes. Bronchopneumonia and pleural effusion were present on the right side. The final diagnosis was malignant pleural mesothelioma.

CASE IX: A 55-year-old white man was admitted on May 29, 1950. Symptoms began one month prior to admission, with cough, dyspnea, and pain in the right lower chest. Two weeks prior to entry the patient was hospitalized elsewhere and found to have a massive right pleural effusion which required four thoracenteses, with the removal of a total of 6 liters of bloody fluid. On admission he had slight fever and signs of fluid in the right chest. The chest roentgenogram revealed massive effusion in the right thorax. Some residual loculated air pockets were present above the fluid. Bronchoscopy disclosed extrinsic pressure on the right main bronchus. During thoracentesis a resistance to the needle was encountered. Papanicolaou studies of the pleural fluid were negative for tumor cells.

A thoracotomy demonstrated a thickened pleura and an old hemothorax. A soft red mass extended from the lateral chest wall into the lower pleural cavity. The mass was removed, but a subcapsular enucleation of a portion was necessary. Pathologic study showed the tumor to be composed of closely packed cells with ovoid and elongated hyperchromatic nuclei. In several instances there was a rosette arrangement. The diagnosis was malignant mesothelioma of the pleura. The patient had an uneventful postoperative course and returned to the care of his physician. He died sixteen months after operation.

CASE X: A 50-year-old cabinet maker was admitted on Nov. 7, 1950. He complained of abdominal pain, localized to the umbilical area, of five days duration. A preadmission chest film (Fig. 15) showed a widened superior mediastinum and an enlarged heart shadow. The heart and lungs were roentgenologically normal. There was some tenderness in the right upper abdomen. Later there developed a pitting edema, ascites, and hepatomegaly, associated with pericardial and pleural effusions. A pericardial tap yielded 350 c.c. of serosanguineous fluid. A left thoracentesis also produced 550 c.c. of serosanguineous fluid. Subsequently, the patient improved and was discharged on Dec. 19, 1950.

He was readmitted on March 14, 1951, stating that he had been well until a month prior to readmission, when generalized aching, dyspnea, fatigue, and chest pain developed. Examination revealed cachexia, pallor, and an enlarged heart. The lungs were clear. The veins of the neck and upper arm were distended. The liver was large and tender. A film of the chest showed increase in the size of the heart and a small right pleural effusion.

Thoracotomy disclosed a mediastinal mass which occupied the space between the auricles and aorta and distended the mediastinal pleura. There was a 3-cm. nodule at the hilus of the left lung. The pericardium was distended and thickened by tumor and in places was found to be adherent to the myocardium. Pathologic studies revealed malig-

nant mesothelioma. The patient died the day after operation.

Autopsy revealed a pleural mesothelioma involving the pericardium and lungs. The pericardium was 1 to 2 mm. in thickness and contained two nodules 1.5 cm. in thickness. The myocardium was not invaded. A larger, more necrotic mass of tumor was present beneath the arch of the aorta and infiltrated the right auricular appendage. Scattered through all lobes of the lung were numerous small brown tumor nodules measuring up to 1 cm. in diameter. Microscopically, the tumor was composed of basophilic cells varying considerably in size and shape. Many of the cells were elongated and spindle-shaped; others were round or ovoid, with frequent mitosis.

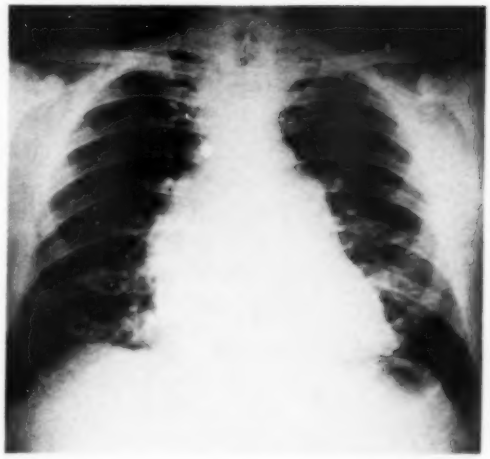

Fig. 15. Case X. Frontal chest film showing widening of the superior mediastinum and an enlarged heart.

CASE XI: A 58-year-old white man was admitted on April 4, 1940. Nine months previously he began to experience easy fatigability and gradual weight loss. Five weeks prior to admission a non-productive cough developed, with dyspnea and a low-grade fever, soon followed by sharp stabbing pain in the right anterior chest. The chest roentgenograms revealed a right pleural effusion extending as high as the third rib anteriorly (Fig. 16A). Four days later (Fig. 16B) there was massive right pleural effusion with marked mediastinal displacement, while physical examination showed dullness with absence of breath sounds over the entire right chest. The patient was critically ill and very weak. Thoracentesis yielded large amounts of serosanguineous fluid and pathologic examination revealed tumor cells. A week after admission the dyspnea and cyanosis became more severe and the patient died.

Autopsy revealed mesothelioma of the right pleura with invasion of the right lower lobe. There were metastases to the tracheobronchial lymph nodes, kidneys, and adrenals. The surfaces of the right pleural cavity were covered with a white granular tissue.

CASE XII: A 64-year-old white man was admitted on May 4, 1953. Two weeks before ad-

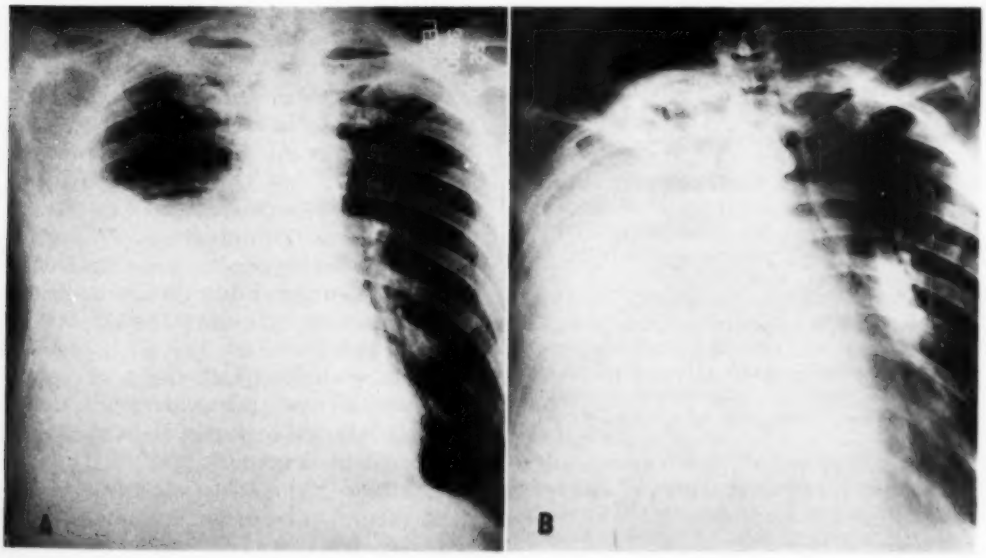

Fig. 16. Case XI. A. Frontal chest film showing right pleural effusion.
B. Chest film, four days later, showing massive pleural effusion with displacement of mediastinum to the left.

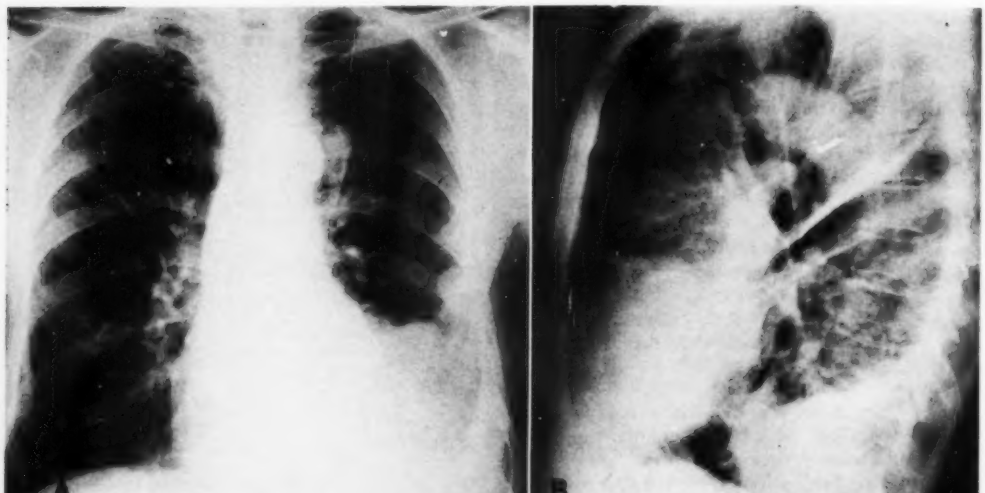

Fig. 17. Case XII. A. Frontal chest film showing nodular masses in left lower lung field and left pleural effusion. A nodular density is seen to the left of the aortic k[illegible]
B. Left lateral view showing the nodular densities in t[illegible]erior inferior portion of the left chest and nodular densities (arrow) in the anterior portion of the superior me[illegible]um. Pleural effusion with interlobar extension is evident.

mission he experienced severe precordial pain, which recurred daily. The chest examination revealed decreased breath sounds and dullness over the left lower lobe. A roentgenogram showed a left pleural effusion with nodular densities in the left lower lung field (Fig. 17). Two large nodular densities (arrow) were noted in the left superior mediastinum. Thoracentesis yielded 40 c.c. of serosanguineous fluid which was positive for tumor cells (Class V, Papanicolaou).

A left thoracotomy disclosed a diffuse pleural tumor, with adherence of the parietal and visceral pleurae. An extrapleural pneumonectomy was performed. The entire left pericardium and the medial portion of the diaphragm were excised because of tumor invasion. Nevertheless, residual tumor remained in the chest wall. Pathologic study showed the pleura to be grossly thickened and covered with numerous hard white nodules measuring up to 1.0 cm. in diameter; many were confluent. The lung parenchyma was grossly normal except for one 3-cm. tumor nodule in the apex. Histologic study revealed polymorphic and anaplastic cells with very little fibrous stroma. The diagnosis was malignant mesothelioma of the pleura.

X-ray therapy (250 kv) to two anterior and two posterior chest portals was instituted on May 25, 1953. By July 30 a total of 2,500 r in air had been delivered to each of the four portals. Neoplastic involvement of the distal esophagus and fundus of the stomach developed, however, and the patient was transferred for terminal care.

DISCUSSION

The diagnosis of mesothelioma of the pleura can be made with certainty only after gross pathologic and histologic study. There are clinical and roentgenographic features, however, which should suggest the disease and help differentiate between the localized and diffuse types. The relationship between the two entities is difficult to determine. Most localized pleural mesotheliomas are benign and fibrous in character (7), but there is good evidence that in some cases the localized may be the early stage of the diffuse type. Furthermore, the disease may appear localized on the roentgenogram but prove malignant on thoracotomy (Cases II and III). Also, Yesner and Hurwitz (8) have reported a localized pleural mesothelioma of epithelial type. Thus, it is evident that not all localized pleural mesotheliomas are benign or fibrous in character.

Localized Pleural Mesothelioma: Localized pleural mesotheliomas are rare and are seen less frequently than the diffuse type. The widespread use of radiographic chest surveys, however, promises to dis-

close more of these lesions in symptomless individuals (Cases I and III) (9). The gross pathologic appearance is that of an encapsulated, lobulated mass which may be very large and pedunculated. Histologic study establishes the diagnosis and in the great majority of instances reveals the characteristic spindle-shaped cells.

Clagett, McDonald and Schmidt (7) reported 24 cases of localized lesions from the Mayo Clinic, 14 in men and 10 in women, with an average age of fifty years. Of our 5 patients, 4 women and a man, 2 were below thirty and the others were forty, fifty and seventy-one years of age. Many of the patients in this group have no respiratory symptoms, but two-thirds of the Mayo Clinic group had symptoms or physical findings referable to the joints and half exhibited clubbing of the digits.

Roentgenography of the chest shows a circumscribed, usually lobulated, intrathoracic mass which is in the plane of the visceral or parietal pleura. There are no characteristic radiographic findings which distinguish it from other mediastinal, pulmonary or pleural tumors. Pleural effusion is uncommon, or a late manifestation. It was present in 4 of the 24 cases in the Mayo Clinic series and in none of our cases. In contrast to the diffuse type there is no evidence of satellite tumor nodules or seeding of the pleura. Therefore, diagnostic pneumothorax is not helpful in the differential diagnosis (10), although Stout and Himadi (11) found it useful in separating a parietal tumor from the lung. Angiocardiography aids differentiation from vascular tumors and demonstrates intact cardiac chambers and great vessels (Cases II and III). In Case III, an unsuspected pericardial effusion was disclosed.

Occasionally, the localized tumor is huge and opacifies the major portion of a hemithorax, simulating a massive effusion (12). These large fibromatous tumors are often lobulated, assume ovoid shapes when located in an interlobar fissure, and may merge with the diaphragmatic shadow when located on the thoracic floor (13). The "giant" forms are usually benign and pedunculated. Rarely they may cause cardiac failure by mechanical pressure (14).

The treatment is thoracotomy with complete excision of the tumor. The prognosis is good unless removal of the neoplasm is incomplete or there is evidence of malignancy. Clagett, McDonald, and Schmidt reported recurrence in 4 of their 24 patients. Radiation therapy should be reserved for patients in whom complete removal of a malignant mesothelioma is impossible or in whom recurrence develops.

Diffuse Pleural Mesothelioma: The diffuse type of pleural mesothelioma is of more frequent occurrence than the localized. Doub and Jones in 1942 (4) reported 3 cases of diffuse mesothelioma among 345,000 admissions to the Henry Ford Hospital. Hochberg in 1951 (3) collected 43 cases among 60,042 autopsies (0.07 per cent). The gross pathologic appearance is that of a markedly thickened pleura with many nodular densities on the surface of the lung. The neoplastic tissue can often be removed *in toto*, forming a cast of the hemithorax (6). The neoplasm characteristically spreads by contiguity and serosal seeding, with the thickest portion occurring at the base of the lung. The parietal and visceral pleurae are both involved and there is usually extension into the lung, mediastinum, pericardium, diaphragm, and chest wall. Distant metastases are uncommon, although large mediastinal, axillary, and supraclavicular lymph nodes are not infrequent. The histologic picture is characterized by the presence of both epithelioid and spindle cells. The diagnosis of pleural neoplasm may also be confirmed by thoracoscopy or thoracotomy with biopsy and by study of the pleural fluid for neoplastic cells. In our series 6 patients had cellular studies of the pleural exudates, and 2 were positive for neoplastic cells.

Most cases occur between the ages of forty and sixty years; only 12.5 per cent are found in the first three decades. Males predominate in the ratio of 1.8 to 1.0 (3). In our series, all 7 patients were males and the ages varied between fifty-four and

sixty-four. The patients usually have mild symptoms in the early stage, with occasional localized pleuritic type pain and symptoms suggesting an upper respiratory infection. The pain later becomes more severe and gnawing in character and is soon accompanied by asthenia, dyspnea, weight loss, dry cough, and fever. In terminal stages, there is usually evidence of involvement of the great veins with development of the superior vena caval syndrome, and there may be recurrent laryngeal or phrenic nerve paralysis.

Roentgenography of the chest usually discloses extensive pleural effusion; on thoracentesis, a serosanguineous or sanguineous fluid is obtained, and there is often a sense of increased resistance to the needle as it pierces the pleura. Relief of symptoms after thoracentesis is transient because of the rapid reaccumulation of fluid. Early, before the occurrence of pleural fluid, a large mass and many satellite nodules may be seen. Later, tumor nodules may be noted above the level of the fluid or pleural thickening. As Doub and Jones have emphasized, a pneumothorax induced after a thoracentesis will often demonstrate the tell-tale pleural nodules and thereby aid diagnosis. Thickened pleura may be noted on the teleroentgenogram (Fig. 12) (15) after the use of over-penetration technic or after the induction of a diagnostic pneumothorax (Fig. 11). In addition, hydropneumothorax, with change in position, can also be used to demonstrate the static nature of the pleural thickening. Despite the large pleural densities and effusion, there is usually little shift of the mediastinum. The pleural thickening is greatest at the base, but the entire pleura may be involved, causing shrinkage of the lung.

The pericardium is frequently involved, and kymography may be of aid in the differentiation of cardiac enlargement and pericardial effusion (16). Although primary mesothelioma of the pericardium has been reported (17), the pericardium is more often involved by contiguous spread from a pleural mesothelioma (Cases X and XII). Involvement of the chest wall may result in erosions of the ribs. Angiocardiography, by demonstrating widening beyond the cardiac chamber space, may aid in the diagnosis of pericardial involvement and effusion. When the lung is compressed by massive pleural thickening and fluid, angiocardiography will also demonstrate the crowding of the pulmonary vessels (18). Furthermore, the demonstration of extensive involvement of the great vessels will suggest non-resectability (Fig. 14) (18, 19).

The prognosis is poor for patients with diffuse pleural mesothelioma. Hochberg (3), reviewing the literature, found 37 deaths among 46 patients during the first year; none were alive after five years. In the absence of clinical or roentgenographic (especially angiocardiographic) evidence to suggest non-resectability or metastatic spread, surgery appears to be the primary therapy and is often essential in order to establish the diagnosis. Diffuse pleural mesothelioma is radioresistant, and radiation therapy is palliative. Radioactive isotopes (I^{131} and Au^{198}) have been used intrapleurally to decrease the formation of the pleural fluid (20).

SUMMARY

Five cases of localized pleural mesothelioma and 7 of diffuse pleural mesothelioma are presented.

Localized pleural mesothelioma is usually a benign disease but may prove to be the early stage of the diffuse malignant type. Roentgenographically, it is manifest as a circumscribed lobulated mass in the plane of the pleura which cannot be differentiated from other intrathoracic tumors. Angiocardiography aids in demonstrating pericardial and great vessel involvement. Clinically, osteoarthropathy is a common feature. The diagnosis can be made only after thoracotomy and microscopic study of the tumor. Prompt surgical therapy with complete removal of the tumor may be curative.

Diffuse pleural mesothelioma, on the other hand, is always a malignant disease. Roentgenographically, it often appears initially as a massive pleural effusion.

Pneumothorax, after removal of the serosanguineous fluid, permits visualization of the nodular pleural densities, an important diagnostic feature. Pleural thickening and rapid recurrence of the pleural exudate, associated with fixation of the mediastinum, are other characteristic roentgen features. Angiocardiography aids the recognition of pericardial and cardiovascular involvement.

ADDENDUM: Since this paper was submitted for publication, Bogardus and colleagues (21) have reported 4 cases of pleural mesothelioma.

ACKNOWLEDGMENT: Thanks are due to Dr. Robert S. Sherman of the Memorial Hospital for permission to include Cases III and VI in this study.

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SUMARIO

Aspectos Roentgenológicos del Mesotelioma Pleural

Preséntanse 5 casos de mesotelioma pleural localizado y 7 de mesotelioma pleural difuso.

El mesotelioma pleural localizado suele ser una afección benigna, pero también puede representar el período incipiente de la forma maligna difusa. Roentgenográficamente, se traduce por una tumefacción lobulada circunscrita en el plano de la pleura, que no puede diferenciarse de otros tumores intratorácicos. La angiocardiografía ayuda a descubir la invasión del pericardio y de los grandes vasos. Clínicamente, la osteoartropatía es una característica frecuente. El diagnóstico no resulta posible sino después de la toracotomía y del estudio microscópico del tumor. La terapéutica quirúrgica inmediata con la extirpación total de la neoplasia puede resultar curativa.

En cambio, el mesotelioma pleural difuso es siempre una enfermedad maligna. Roentgenográficamente, aparece a menudo inicialmente como un derrame pleural masivo. El neumotórax, después de la extracción del líquido serosanguíneo, permite la visualización de las densidades nodulares en la pleura, característica ésta

importante para el diagnóstico. El engrosamiento pleural y la rápida recurrencia del exudado pleural, unidos a la fijación del mediastino, constituyen otras típicas características roentgenológicas.

Por revelar la dilatación que existe más allá del espacio de la cavidad cardíaca, la angiocardiografía puede ayudar en el diagnóstico de la invasión pericardíaca y del derrame. Cuando el pulmón está comprimido por masivo espesamiento y líquido pleural, la angiocardiografía revelará además el hacinamiento de los vasos pulmonares. Aun más, el descubrimiento de la invasión extensa de los grandes vasos sugerierá que no cabe hacer la resección.

The Early Recognition of Premature Cranial Synostosis[1]

JOHN W. HOPE, M.D., EUGENE B. SPITZ, M.D., and HARRY W. SLADE, M.D.[2]

THE CHARACTERISTIC roentgen findings in a child with a fully developed craniostenosis are known to most radiologists. These older children have misshapen heads and various neurological disorders, and the roentgenographic picture is typical. For example, closure of all the sutures gives rise to oxycephaly. Such a case is shown in Figure 1. The patient was a female of two and one-half years who was admitted because of a peculiarly shaped skull and a severe exophthalmos. Her vision was already impaired, and she was mentally retarded. The roentgenograms reveal closure of all the sutures. The skull has a turricephalic contour, indicating that the region of the anterior fontanel was probably the last to close. The digital markings are increased; the floor of the middle fossa is depressed and bulges forward.

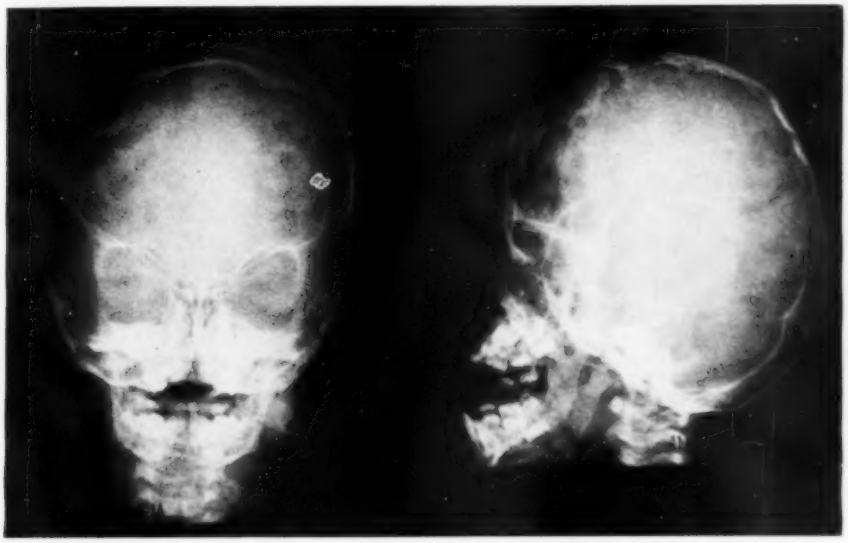

Fig. 1. Two-and-one-half-year-old female with a peculiarly shaped skull, exophthalmos, impaired vision, and mental retardation. There is closure of all the sutures with a turricephalic contour, increased digital markings, and depression and forward bulging of the middle fossa.

Another fully developed case of premature cranial synostosis is shown in Figure 2. This patient was a three-year-old female who also had a peculiarly shaped skull. At the time of admission her mentality was normal, but there were three diopters of papilledema bilaterally. The postero-anterior roentgenogram shows the sagittal suture to be open. The lateral view indicates a shortening of the antero-posterior and an increase in the vertical diameter of the cranial vault. The coronal and lambdoidal sutures are closed. There is a great increase of the digital markings. Note also the coincidental bilateral parietal foramina.

Figure 3 shows another typical advanced

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[1] From the Departments of Radiology and Neurosurgery, The Children's Hospital of Philadelphia, Philadelphia, Penna. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

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type of craniostenosis, in a two-year-old female who was examined because of an elongated narrow skull. In the postero-anterior view, the sagittal suture is closed. The lateral view shows a dolichocephalic contour with the coronal and lambdoidal sutures open. This is a case of scaphocephaly.

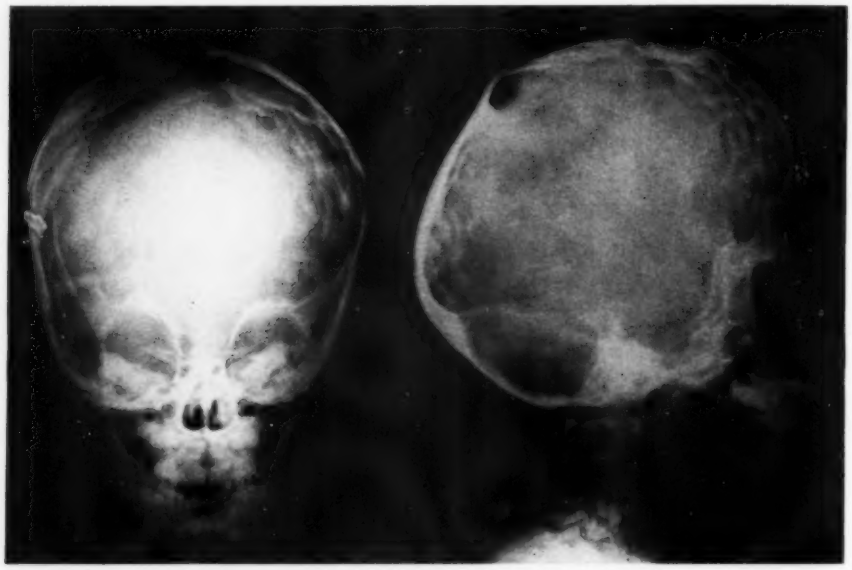

Fig. 2. Three-year-old female with a peculiarly shaped skull and three diopters of papilledema bilaterally. The sagittal suture is open, but the coronal and lambdoidal sutures are closed. Note the bilateral parietal foramina.

These three illustrative cases are relatively simple problems in roentgen diagnosis, but in each case the child was two years of age or older. The symptoms presented, other than a peculiar appearance, were visual difficulties caused by optic atrophy, deafness, and mental retardation.

There is little satisfaction in knowing the roentgen findings in these late cases, after irreparable damage has been done to the brain. The important aspect of this disease is its early recognition, before the damage has occurred. The purpose of this paper is to point out the early clinical and roentgen findings of premature cranial synostosis.

Normal skull growth forms a parabolic curve graphically (1). There is a slight separation of the cranial sutures at birth, and firm fibrous union at five to six months. At the end of the sixth week, the anterior and posterior fontanels are protected by sturdy fibrous attachments, with the normal closure of the anterior fontanel occurring between the tenth and sixteenth month. There are, however, perfectly normal children in whom the anterior fontanel may remain open until eighteen to twenty-four months of age. The cranial sutures normally fuse long after the growth of the brain has been completed. Only the metopic suture closes at birth or shortly thereafter, the others remaining open until the age of fifty or sixty years (2).

Growth of the skull and obliteration of the sutures is a direct function of normal brain growth. The brain doubles its weight in the first seven months of life and triples it in thirty months (3). Eighty per cent of its entire growth is completed within the first three years (4).

Premature closure of one or more of the sutures of the cranial vault will result in marked abnormality in the shape of both the skull and the enclosed brain. When a suture is closed prematurely, growth of the

skull perpendicular to this suture is markedly restricted, and compensatory overgrowth takes place at the open sutures to allow space for the growing brain.

Thus, early closure of the sagittal suture will cause a long narrow skull, called *scaphocephaly* or *dolichocephaly*. Closure of the coronal suture will result in a broad, short, occasionally high skull, or *brachycephaly*. This type of deformity also produces a short oblique floor of the anterior fossa and shallow orbits, with widely separated and prominent eyes. Closure of the coronal, sagittal, and lambdoidal sutures results in expansion of the skull upward only at the anterior fontanel, forming a small head, narrow at its apex, with shallow orbits, an almost vertical base, and obliterated sinuses—*oxycephaly*, *acrocephaly*, or *turricephaly*. Premature closure of one side of a transverse suture results in asymmetry, called *plagiocephaly* (Fig. 4). A premature closure of the metopic suture *in utero* creates a pointed forehead, or *trigonocephaly*.

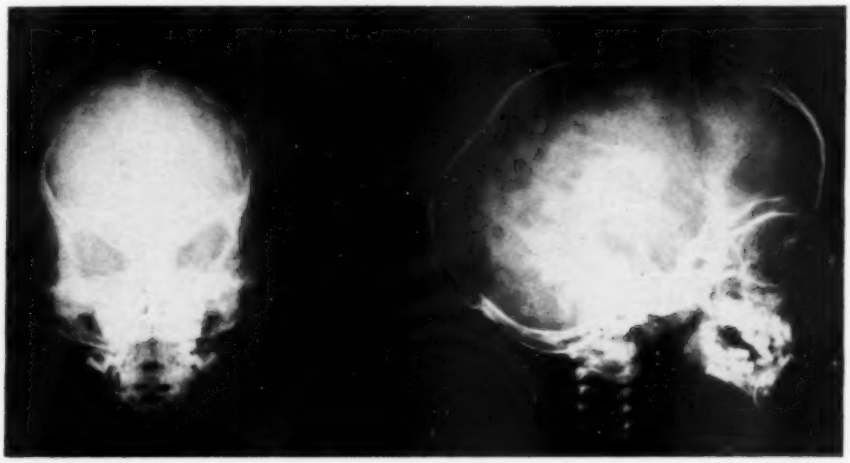

Fig. 3. Two-year-old female with an elongated narrow skull. The sagittal suture is closed, but the coronal and lambdoidal sutures are open. This is a case of scaphocephaly.

The factors incriminated in the possible etiology of craniostenosis are many, but none has stood the test of time and investigation. We know of no specific infection or metabolic defect which might cause it. Repeated study of the bone involved in the premature synostosis has demonstrated no abnormality under gross or microscopic examination (5).

PHYSICAL FINDINGS

Early clinical features important in the diagnosis of craniostenosis before the late signs of decompensation are as follows:

1. An abnormally shaped head should arouse suspicion. In many instances, the diagnosis may be made at birth.
2. Examination of the head will frequently disclose a palpable ridge over the closed suture, and movement of the adjacent skull bones is not possible. It is important to recognize the fact that the sutures may appear partially open on the roentgenograms, although at the operating table the bones are found to be firmly adherent.
3. Exophthalmos is a frequent sign when closure of sutures results in a shallow anterior fossa. In scaphocephaly, exophthalmos is seen less frequently.
4. Because of the paucity of clinical findings which can be observed at an early period, the diagnosis is usually made by roentgen examination.

As long as compensatory growth exists which utilizes uninvolved open sutures, the abnormal shape of the skull may rep-

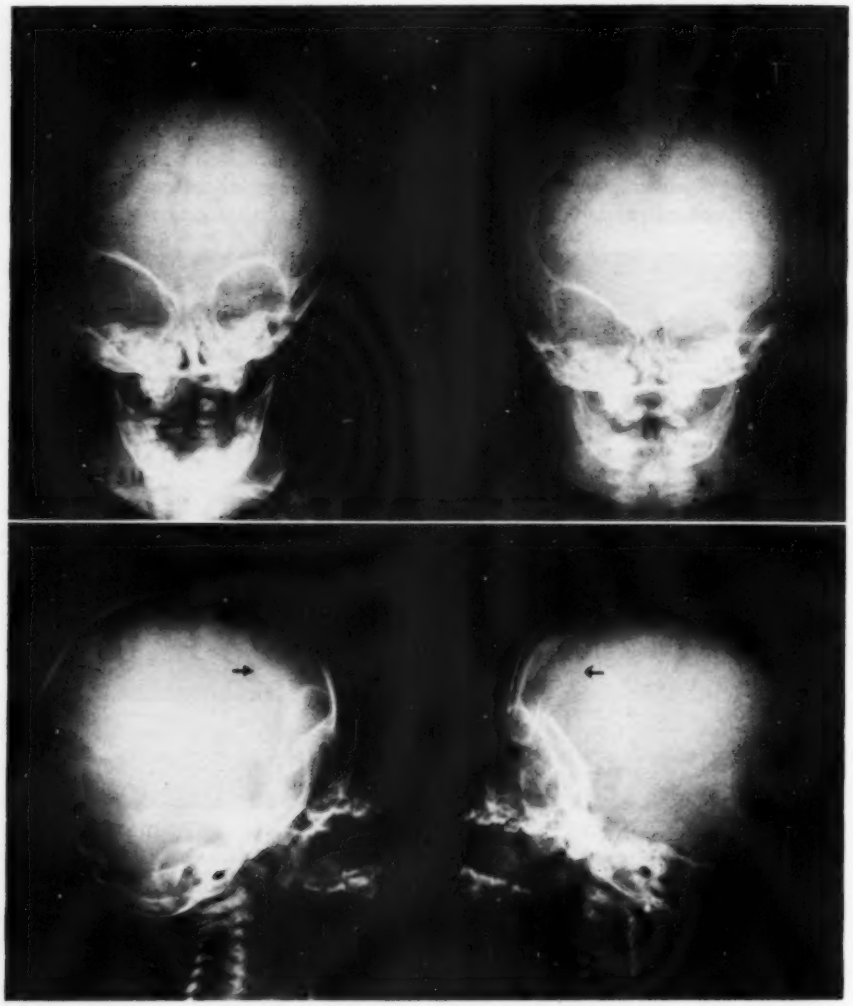

Fig. 4. Nine-month-old female who had an asymmetrical skull with the right frontotemporal region flattened as compared with the left side. Above are two postero-anterior roentgenograms of different densities. The right half of the coronal suture is closed (arrows). All the other sutures are open. Note also the upward and lateralward slant of the roof and lateral border of the right orbit. The metopic suture curves over to the right. Below are two lateral views which show the right half of the coronal suture to be closed (arrows). This is a case of plagiocephaly.

resent the only indication of the disease. When decompensation takes place, however, additional changes result from increased intracranial pressure. These include mental retardation, convulsive seizures, papilledema, headaches, vomiting, failing vision, optic atrophy and blindness, palsy of the third, fourth, and sixth nerves, occasional involvement of the first and eighth cranial nerves, and deafness.

ROENTGEN FINDINGS

It is almost impossible to describe the roentgen appearance of a normal suture and suture margins in the first few months of life because it is so variable. Some normal infants have very wide sutures, while in others they are narrow. It is not normal, however, for a baby to have extremely narrow sutures with increased density of the bone margins. A suture which will

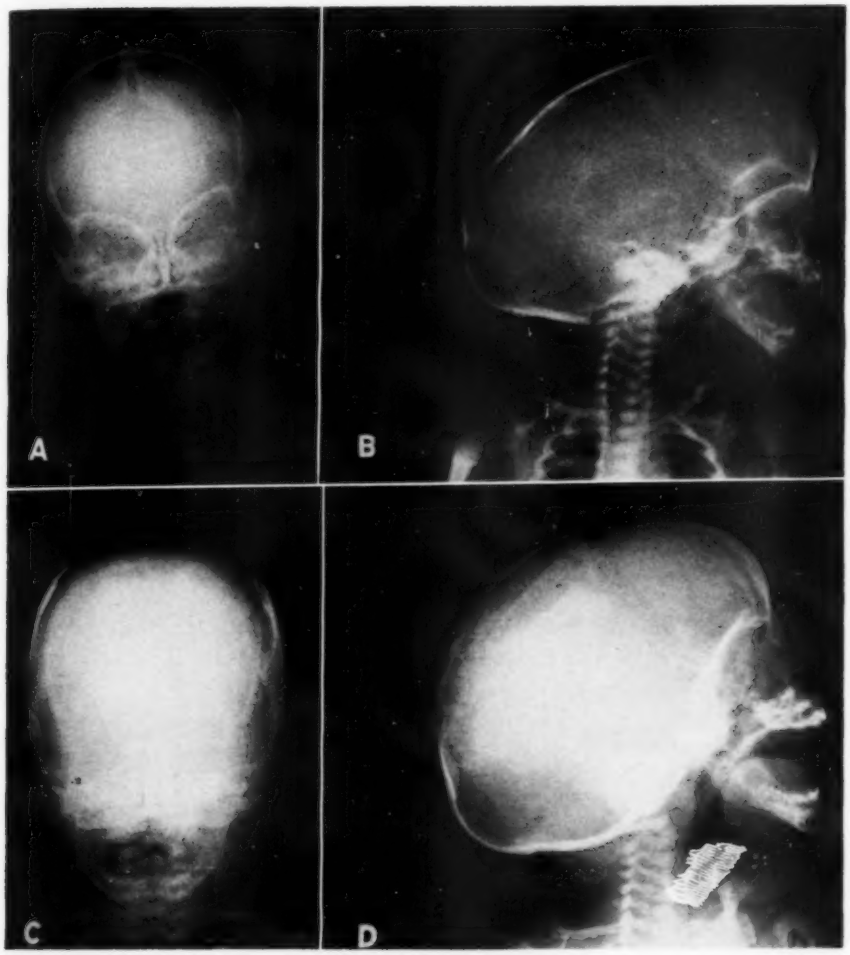

Fig. 5. Case I: One-month-old male with a narrow and elongated skull.
A. Postero-anterior roentgenogram showing increased density along the edges of the sagittal suture, with partial closure of the suture.
B. Lateral view showing a scaphocephalic contour, with the coronal and lambdoidal sutures open. Note the increased density of the edges of the parietal bones along the sagittal suture.
C. Postero-anterior roentgenogram one month after performance of bilateral sagittal craniectomies.
D. Lateral view at the same time as C, showing disappearance of most of the scaphocephalic contour.

close prematurely is very narrow, with dense bone margins (Case I, Fig. 5; Case II, Fig. 6; Case IV, Fig. 8). At times the bone is heaped up on each side of the narrow suture (Case III, Fig. 7). Occasionally even at birth the involved suture is already closed. Even before closure occurs, the roentgenograms reveal an abnormal contour. Once a suture has closed, compensatory growth takes place wherever sutures remain open. Later on, compensatory expansion along free suture lines becomes inadequate, and cerebral growth then causes progressively increasing intracranial pressure, which in severe cases may reach levels as high as 500 mm. of water (6). This increased pressure causes thinning of the inner table of the vault and a great increase of convolutional markings (Figs. 1–3). Some cases even reach the

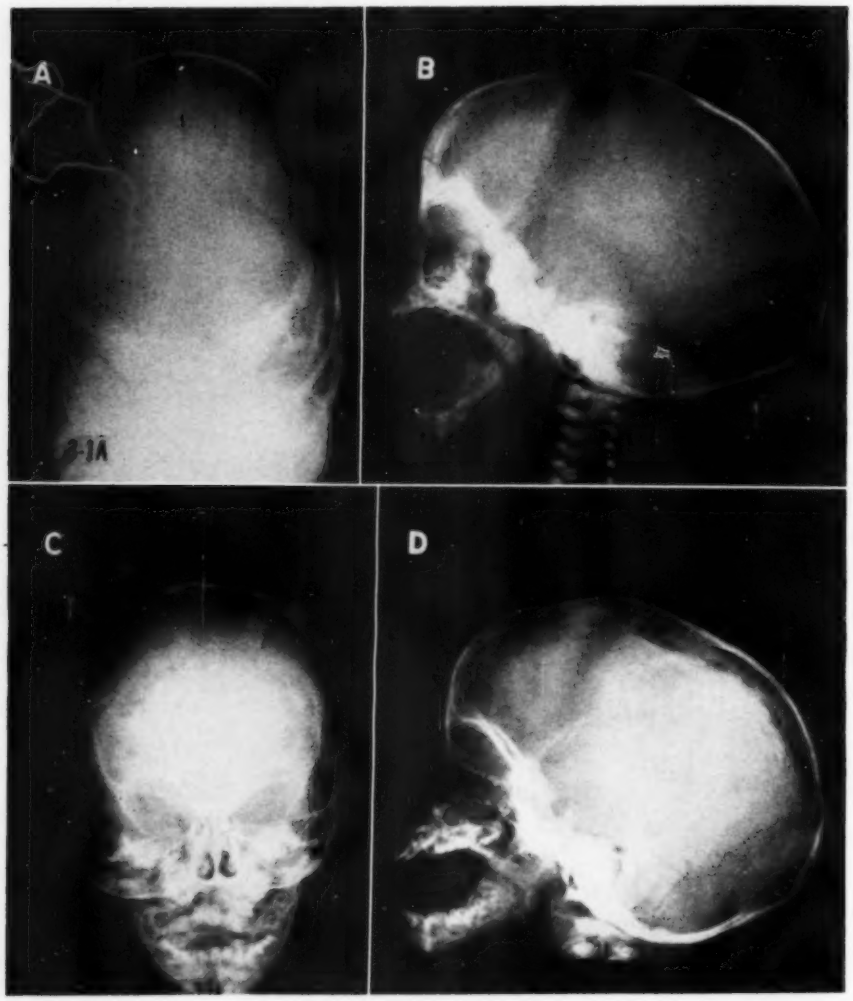

Fig. 6. Case II: Eighteen-day-old male infant with a small anterior fontanel.
A. Occipital roentgenogram showing a partial closure of the sagittal suture.
B. Lateral view showing a scaphocephalic contour with the coronal, squamosal, and lambdoidal sutures wide open.
C. Postero-anterior roentgenogram eight months after bilateral craniectomies were done on each side of the sagittal suture, showing a normal transverse diameter. The sagittal suture has completely closed.
D. Lateral view at the same time as C, showing the operative defects and an almost normal contour.

point of penetration, with spontaneous herniation of the brain. The orbital plates are depressed, resulting in exophthalmos. In some instances, the convolutional markings may be mistaken for Lückenschädel.

CASE REPORTS

CASE I (Fig. 5): A male infant, one month old, with a peculiarly narrow and elongated skull, was admitted because the pediatrician felt a prominent ridge along the line of the sagittal suture. The lateral skull roentgenogram (Fig. 5B) showed a scaphocephalic contour with the coronal and lambdoidal sutures wide open. In the postero-anterior view (Fig. 5A), the parietal bones along the edge of the sagittal suture were seen to be thickened, and much of the suture to be already closed. At thirty-three days of age bilateral craniectomies were performed, paralleling the sagittal suture. In a repeat roentgen examination at two months of age (Fig.

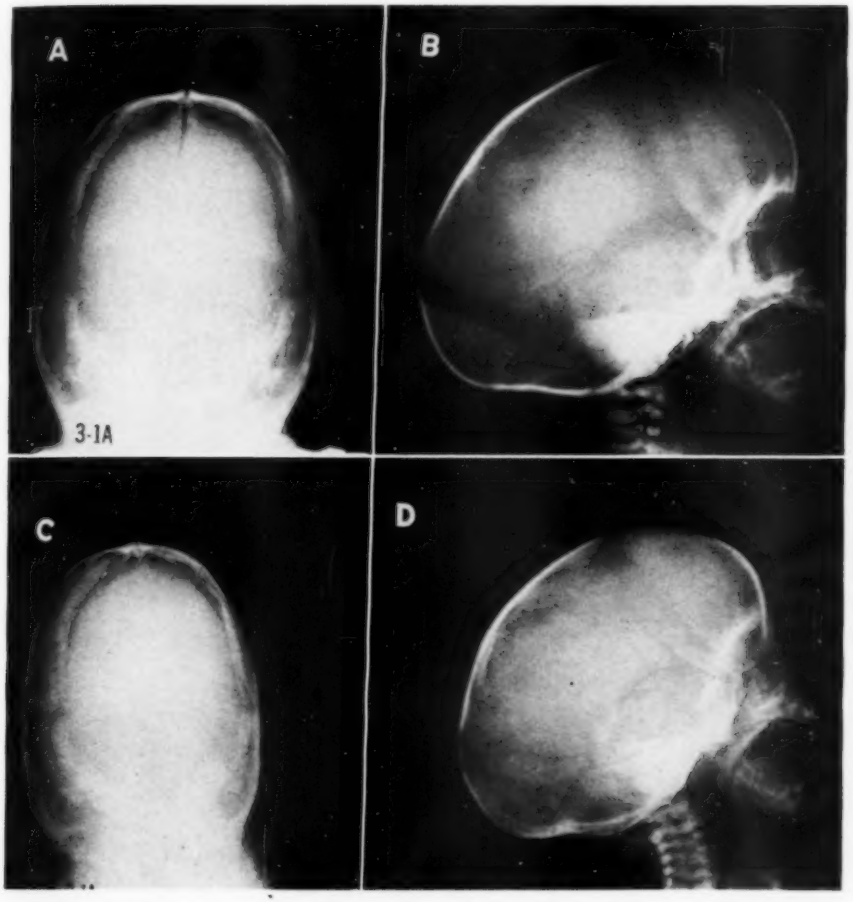

Fig. 7. Case III: Three-week-old female examined because the anterior fontanel and sagittal suture felt closed on physical examination.
A. Occipital view showing a narrow sagittal suture with heaped-up margins.
B. Lateral view showing a scaphocephalic contour, with open coronal and lambdoidal sutures.
C. Occipital view at twelve weeks of age showing closed sagittal suture.
D. Lateral view at twelve weeks showing the coronal and lambdoidal sutures still open.

5, C and D), the skull had lost most of its scaphocephalic contour. The child is now two years old, normal in mentality and appearance.

CASE II (Fig. 6): A male infant, eighteen days old, was brought for a skull examination because his pediatrician could not palpate an anterior fontanel. The occipital view (Fig. 6A) showed that the sagittal suture was closing prematurely. In the lateral view (Fig. 6B), a scaphocephalic contour was observed, with the coronal, squamosal, and lambdoidal sutures wide open. Bilateral craniectomies on each side of the sagittal suture were performed at twenty-three days of age. A second roentgen examination of the skull, at nine months (Fig. 6, C and D), revealed a normal contour. The baby, now one and one-half years old, is mentally alert and has a normal appearance.

CASE III (Fig. 7): A female infant, three weeks old, was seen for a skull examination because the anterior fontanel and sagittal suture seemed to be closed. The occipital view (Fig. 7A) showed a narrow sagittal suture with heaped-up margins. The lateral view (Fig. 7B) revealed a scaphocephalic contour, with wide open coronal and lambdoidal sutures. The important sign in this case was the heaping up of the bone along the edges of the sagittal suture. The child was not operated upon immediately but received another skull examination at twelve weeks of age (Fig. 7, C and D). The sagittal suture had closed in the intervening

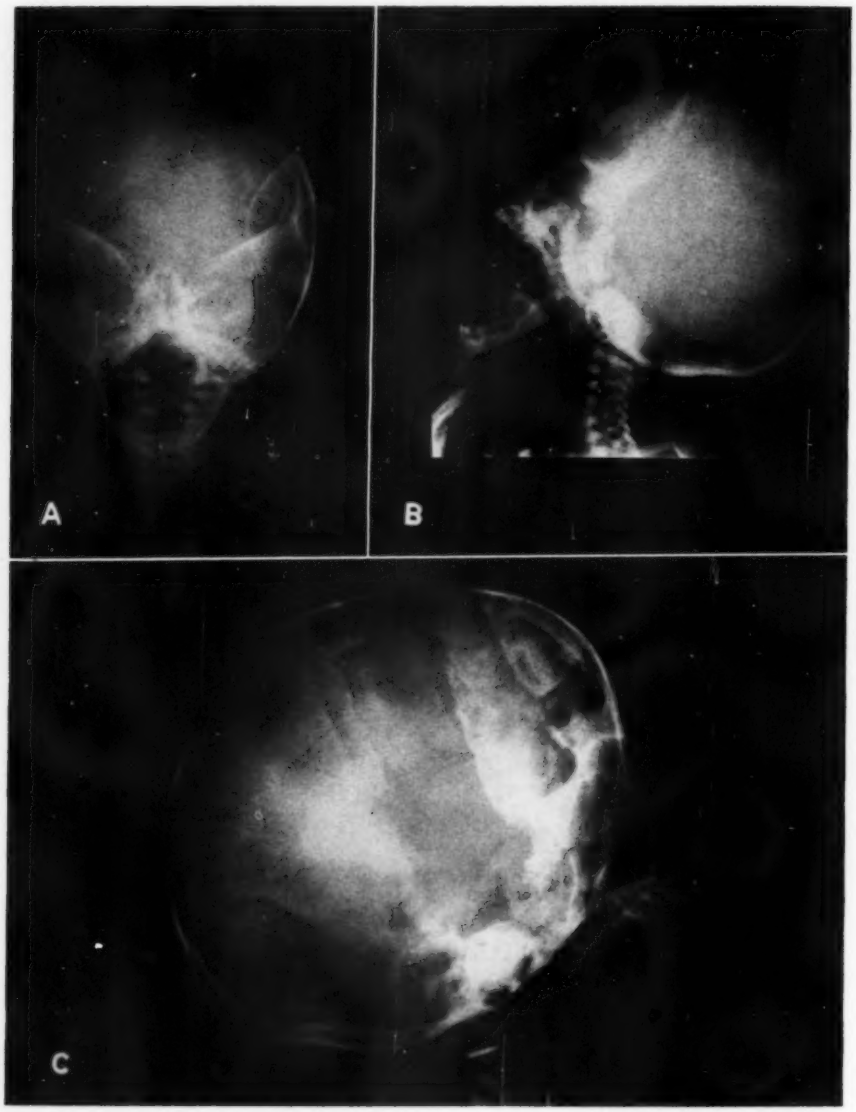

Fig. 8. Case IV: Two-week-old male infant with a ridge on each side of the head in the region of the coronal suture.

A. Postero-anterior roentgenogram showing a wide open sagittal suture. The semicircular lines of increased density on each side are artefacts produced by the edge of a pair of anesthesia cones used to hold the head.

B. Lateral view showing partial closure of the coronal suture and increased density of the bone margins where it is still open. Note also a shortening of the anteroposterior diameter, with an abnormally short frontal region.

C. Appearance of the skull one month after bilateral craniectomies were performed at the site of the closed coronal suture.

nine weeks. Shortly after this examination, bilateral parietal craniectomies were performed on each side of the sagittal suture. Now, at two years of age, mentality and appearance are normal.

CASE IV (Fig. 8): On physical examination, a two-week-old male infant was found to have a ridge on each side of the head in the region of the coronal suture. The roentgenograms showed an increased

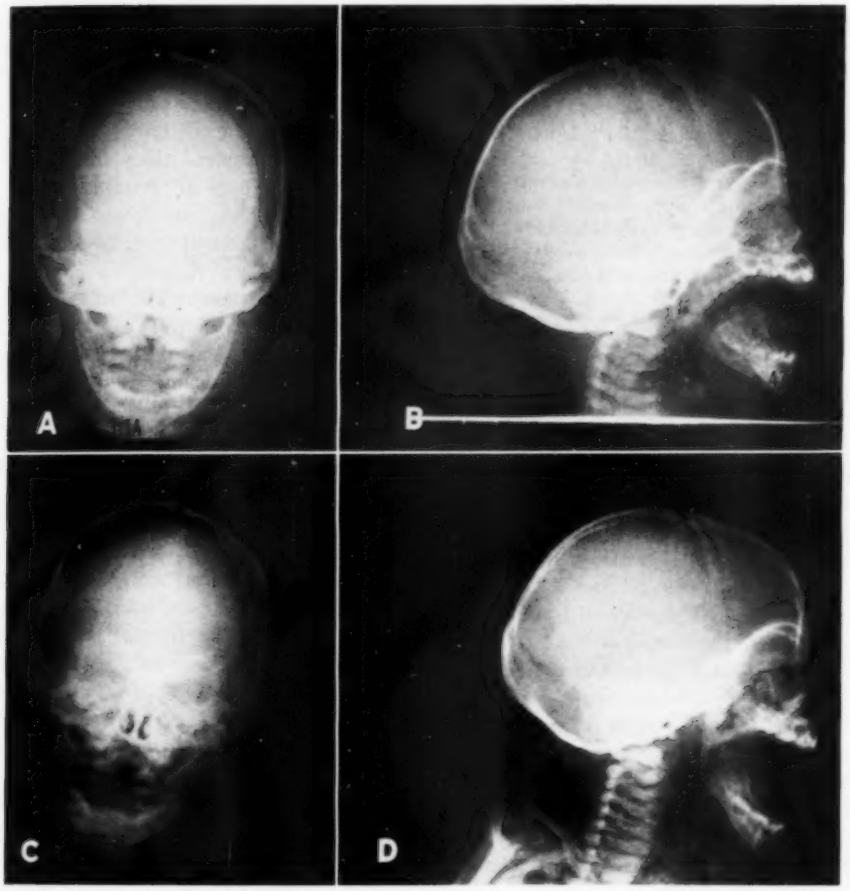

Fig. 9. Case V: Three-month-old female examined because the sutures seemed closed and a ridge of bone could be felt along the sagittal suture.

A. Postero-anterior roentgenogram showing the coronal suture to be open with no abnormal density of the bone margins. The anterior fontanel is open. There is a ridge of bone along the sagittal suture, but it is due to overlapping of the bone edges.

B. Lateral view shows apparent closure of the coronal suture, but this is due to actual overlapping of the bone margins. The lambdoidal suture is open.

C. Postero-anterior roentgenogram at six months of age. The coronal and sagittal sutures are open and the margins appear normal. Note how the sagittal suture is a little off center.

D. Lateral view at six months of age showing the sutures all to be open. The increased density paralleling the coronal suture is false, as seen in the postero-anterior view. This is a case of microcephaly with apparent closure of the sutures.

density of the margins of the coronal suture, and partial closure of the coronal suture low in the region of pterion (Fig. 8B.) All the other sutures were open (Fig. 8A). The vault had failed to fill out in the frontal region and was abnormally high and wide. Thus, the case was one of premature closure of the coronal suture. At three months of age, bilateral craniectomies were performed in the region of the coronal suture. A repeat skull examination one month later showed a more normal appearance (Fig. 8C). At one year of age, the child is normal in mentality and appearance.

CASE V (Fig. 9): A three-month-old female was referred for examination because, on physical examination, the sutures seemed to be closed and a ridge of bone could be felt along the sagittal suture. The roentgenograms show a small head but no disproportion between the vault and the face. The coronal and sagittal sutures are seen to be narrow but not closed. The increased density along their

margins results from an overlapping of the edges of the bones. In the lateral view (Fig. 9B), the edges of the coronal suture appear dense but in the postero-anterior view (Fig. 9A) the suture is open with no increased density of the margins. The same is true of the sagittal suture, where the palpable ridge results from an overlapping of the bone edges. We suspected that we were dealing with a cerebral dysgenesis rather than a true premature closure of the sutures. The child was re-examined at six months. At that time it was clear that she was mentally retarded and had a microcephalic appearance. The sutures were still open (Fig. 9, C and D), but again, because of projection of overlapping margins, the edges appear dense. There are no convolutional markings. This, then, is a case of microcephaly secondary to cerebral dysgenesis.

TREATMENT

Faber and Towne (7) in 1927 described the most logical type of surgery, a preventive operation in which a strip of bone 2 cm. wide, adjacent to the prematurely closed suture, is removed in the first three months of life. This operation was designed to allow the development of normal skull contours and to prevent the occurrence of subsequent visual, mental, or auditory difficulties. A later report on the encouraging results of this type of operation was published in 1943 (6). King (8) developed a more extensive procedure, which consisted of cutting the skull into small squares. This came to be known as the morcellation technic.

Because of the rapid growth of the brain during the first year of life, operation should be performed before six months and preferably at about three months of age. Linear craniectomies tend to close in four to eight months after being created (2). For this reason, various materials designed to keep new bone from forming and closing the artificial suture have been tested. Polyethylene is the most successful substance for this purpose to be used thus far. Strips of this plastic material are sewed over the raw bone edge, thus retarding the formation of new bone.

DIFFERENTIAL DIAGNOSIS

The most important differential diagnosis is that between premature cranial synostosis and cerebral dysgenesis. Many babies with cerebral dysgenesis are examined because the sutures feel as if they have closed prematurely (Case V, Fig. 9) and the anterior fontanel is too small for the child's age. Frequently these infants do not look microcephalic when first seen. The sutures appear narrow because the abnormal underlying brain is unable to exert the normal outward pressure required to keep them separated. The edges paralleling these sutures often appear dense. Upon close inspection in various projections, however, this density is found to be the result of overlapping of the sutures rather than excessive bone formation. These sutures do not close prematurely, and, although one projection may show them apparently closed, in another view they will appear to be open. The bones of the cranial vault will show no convolutional markings because there is no pressure upon the inner table. It is important to pay close attention to the mental development of the infant. One does not want to delay operation in a true craniostenosis, but neither does one wish to operate upon a microcephalic. There are times when a short delay and serial films will help in arriving at the diagnosis.

CONCLUSIONS

1. Untreated premature cranial synostosis is often accompanied by serious sequelae, such as visual and auditory difficulties, mental impairment, convulsive seizures, and bizarre appearance.

2. Eighty per cent of the entire growth of the brain is completed within the first three years of life.

3. Because of the rapid growth of the brain during the first year of life, operation should be performed before six months and preferably at about three months of age.

4. An early diagnosis of premature cranial synostosis is usually possible by physical and roentgen examination.

5. The serious sequelae can almost always be prevented by early diagnosis and operation.

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SUMARIO

El Reconocimiento Temprano de la Sinostosis Craneal Prematura

El diagnóstico de la sinostosis craneal prematura después de la edad de dos años es relativamente sencillo. El punto importante en la enfermedad es el reconocimiento temprano antes de que el cerebro haya experimentado lesiones irreparables.

El cierra prematuro de una o más de las suturas de la bóveda craneal dará por resultado una anomalía acentuada tanto del cráneo como del cerebro. Si no se trata, puede ir acompañada de graves secuelas, tales como dificultades visuales y auditivas, convulsiones, insuficiencia mental y aspecto peculiar. Debido al rápido desarrollo del cerebro durante el primer año de vida, hay que ejecutar la operación antes de la edad de seis meses, y preferiblemente hacia los tres meses. En los casos incipientes, los hallazgos clínicos tal vez sean pocos, y suele hacerse el diagnóstico radiológicamente. Las suturas sumamente estrechas con bordes óseos espesos son típicas de la dolencia. A medida que prosigue el crecimiento del cerebro, aumenta la presión intracraneal, ocasionando adelgazamiento de la lámina interna de la bóveda y acentuación de las marcas de las circunvoluciones.

Casi siempre pueden impedirse las secuelas graves por medio del diagnóstico y de la operación tempranos. La afección más importante que hay que diferenciar de la sinostosis craneal prematura es la disgenesia cerebral.

Arthritis of the Hip Following Urinary Tract Operation[1]

EDWIN L. LAME, M.D.

THE DESTRUCTIVE lesion of the pubes and ischia (osteitis pubis) following operation upon the urinary tract has been of interest to radiologists as well as urologists in recent years. Usually it is a benign self-limited disease that is closely related to, if not identical with, mild osteomyelitis. It occurs almost solely after cystotomy or prostatectomy.

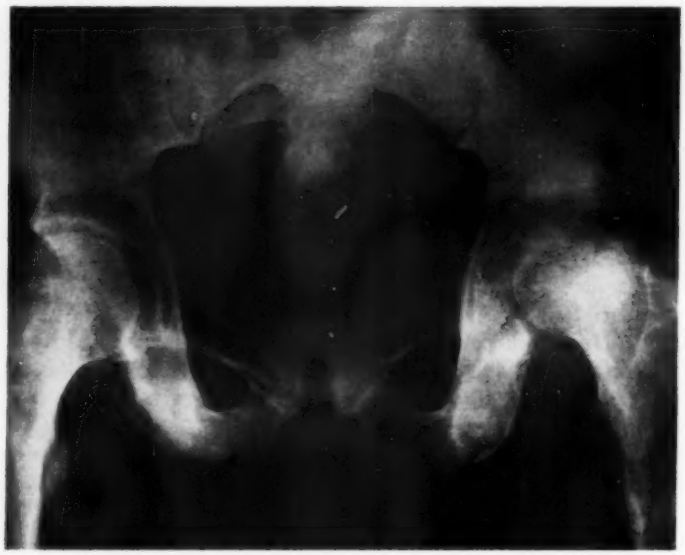

Fig. 1. Case of Dr. Z. B. Friedenberg. Left hip destruction as first demonstrated two months after onset of hip pain and eleven months after prostatectomy. The acetabulum is already enlarged and the femur laterally displaced. Note healing stage of pubes and ischia.

Among the 9 cases of osteitis pubis previously reported by us (5) was 1 in which a destructive arthritis of the hip developed. It is our purpose here to summarize what is known of the hip lesion, to present some ideas on its relationship both to its predecessor and possible successors, and to refer to 3 other cases described in the past forty-three years.

Rarity is not the only cause for interest in arthritis of the hip following urinary tract surgery. Osteitis pubis was first described in 1923 (6) as a serious osteomyelitis with associated septicemia. Cases occurring in the intervening years have been mild. However, the discovery of even 4 instances of hip joint destruction again identifies the disease as potentially dangerous, creating not only respect for the malady, but concern for what other metastatic involvement may appear, beyond the hip area, in any similar group of surgical patients (a subject for discussion elsewhere).

PREVIOUSLY REPORTED CASES

1. The earliest case found is that of Kretschmer and Ockuly (4), dating back to 1911. Following a suprapubic prostatec-

[1] From the Department of Radiology of The Presbyterian Hospital in Philadelphia, Philadelphia, Penna. Accepted for publication in July 1954.

tomy, complete destruction of the right hip joint occurred after an unstated interval. The roentgenograms have been destroyed. There was no suppuration, and recovery took place in three months. The lower limb was shortened, suggesting, in retrospect, absorption of the femoral head or formation of a false acetabulum. Nothing was said of osteitis pubis, which, at that date, had not been reported. The authors concluded that the hip lesion was the result of a blood stream infection.

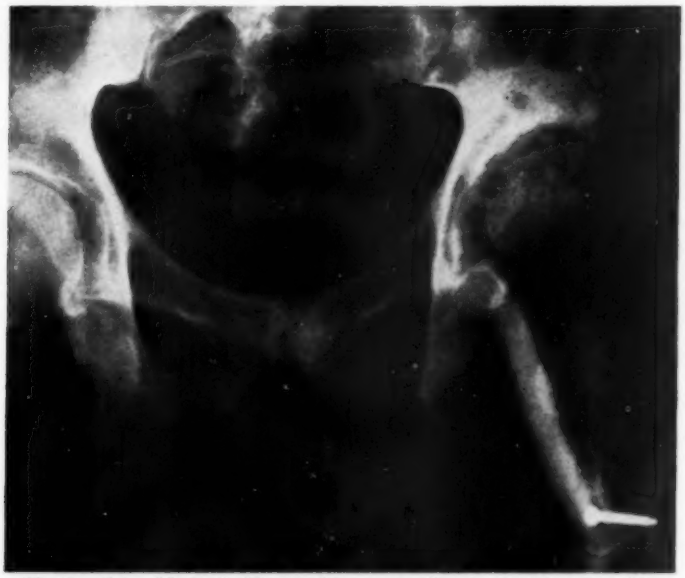

Fig. 2. Same hip as in Fig. 1, three years after prostatectomy and two years after grafting. Further destruction and enlargement of the acetabulum have occurred in the interval. No hip pain.

Roentgenograms for Figs. 1 and 2 loaned by Dr. E. P. Pendergrass; reproduced by courtesy of *Journal of Bone and Joint Surgery* (32-A: 924, 1950).

2. The second case is that of Silver (8). Of 4 patients with osteitis pubis complicating prostatectomy, 1 suffered bilateral destruction of the femoral heads and hip joints, with formation of secondary acetabula and subluxation of the femora. These hip lesions were not cured after twenty-four months. The author did not discuss cause.

3. The last reported case is that of Friedenberg (3), who has generously permitted a complete description here:

In a white male of sixty-four years osteitis pubis developed four weeks after the second stage of a suprapubic prostatectomy. Urine culture revealed *Pseudomonas aerogenes* and non-hemolytic *Streptococcus*. At nine months postoperatively left hip pain occurred. Hip function was markedly reduced at eleven months, when the patient presented himself for examination, and roentgenograms showed a destructive arthritis (Fig. 1). Urine culture produced *Pseudomonas* six times (twice with *Staphylococcus albus*). Biopsy of the hip disclosed thin pus, which produced *Pseudomonas*, and a non-glistening femoral cartilage, partially detached and fibrillated. Rapid progress of the lesion prompted an extra-articular graft for fusion.

After six months in plaster, the patient had very little pain. A roentgenogram two years after grafting (Fig. 2) revealed further destruction (which may have occurred only in the first portion of the interval). At three years there was no hip pain, but some in the ischium, where the graft had become loose.

The author states that in its clinical and roentgenological course the disease resembled a low-grade osteomyelitis.

PRESENT CASE

(Courtesy of Dr. Francis C. Harrison)

A white male of fifty-five years had a suprapubic prostatectomy on July 30, 1948, for benign hypertrophy. Four weeks postoperatively osteitis pubis

developed. Culture of the urine produced *Escherichia coli* once and *Pseudomonas aerogenes* once. A blood culture was contaminated and was not repeated. Intensive treatment by streptomycin, penicillin, and sulfonamides was without benefit. Roentgen therapy produced a prompt relief of pain, and the patient was without symptoms in five weeks.

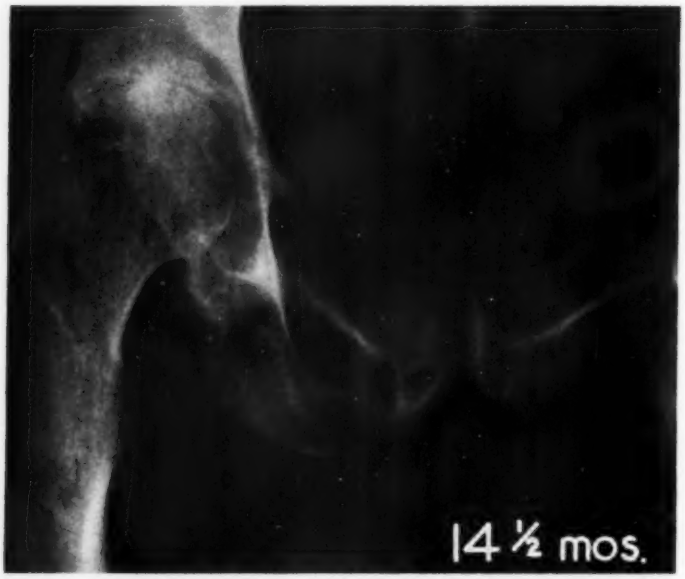

Fig. 3. Current case, fourteen and a half months after onset of osteitis pubis. Healed stage of pubes and ischia. Combined osteoblastic and osteolytic lesion in hip with narrowed joint space, but no lateral displacement of femur. Pain and marked limitation of motion.

Three weeks later (fourteen weeks postoperatively) pain and limitation of motion developed in the right hip, but, rather than return to Philadelphia, the patient had roentgenograms made nearer to his home. These revealed no hip lesion, simply the healing stage of the pubic disease. The hip pain was attributed to the old pubic lesion, and more irradiation was given to this area, without benefit.

The patient spent most of the following winter and spring in bed, not returning to Presbyterian Hospital until fourteen and a half months after the onset of osteitis pubis. Progressive loss of function and marked hip joint destruction had occurred (Fig. 3). The pubes and ischia were well healed, the hip obviously was the cause of all complaints. Recommended orthopedic care was rejected.

At three years postoperatively, the patient had a moderate amount of pain on weight-bearing and severe limitation of motion (Fig. 4), but he was working at his business of farm supervision. Further roentgen study at five and three-quarter years was refused. Although the man reported that automobile travel still caused hip pain, he was able to walk without a cane and was working regularly.

ETIOLOGY

Kretschmer and Ockuly believed that the hip disease in their case was due to a blood stream infection. Friedenberg's data show that a *Pseudomonas* suppurative arthritis resulted in a patient carrying *Pseudomonas* in the urine. In our case the urine showed colon bacillus once and *Pseudomonas* once during the pubic disease and before the occurrence of hip symptoms. No biopsy was possible to confirm the theory that these organisms were causative.

Information accumulated in the various studies on osteitis pubis is valuable in assessing the etiology of the hip involvement (5). First, these reports indicate that the common urinary tract organisms, *Escherichia coli*, *Staphylococcus aureus*, *B. proteus*, *Pseudomonas aerogenes* (*B. pyocyaneus*) and *Streptococcus* persist for a remarkably long time in the urine, despite preoperative and postoperative use of sulfonamides and antibiotics. Secondly, these organisms must be highly resistant to

therapy when they reside in cartilage and bone, judged by the experience of all authors with the chronic pubic and ischial disease. Thirdly, bone biopsies secured from these patients have demonstrated colon bacilli, *B. proteus*, *Staphylococcus aureus*, and *Pseudomonas* organisms.

With increasing knowledge of the blood vascular system of bones and joints, the pathogenesis of the hip arthritis can be explained better than heretofore. The anatomic drawings (Fig. 5) of Ribet (7), the work of Batson (1) and of French authors (2), and our own bone phlebograms in the living (Fig. 6) demonstrate close and multiple venous connections linking soft tissue, pubis, ischium, and hip.

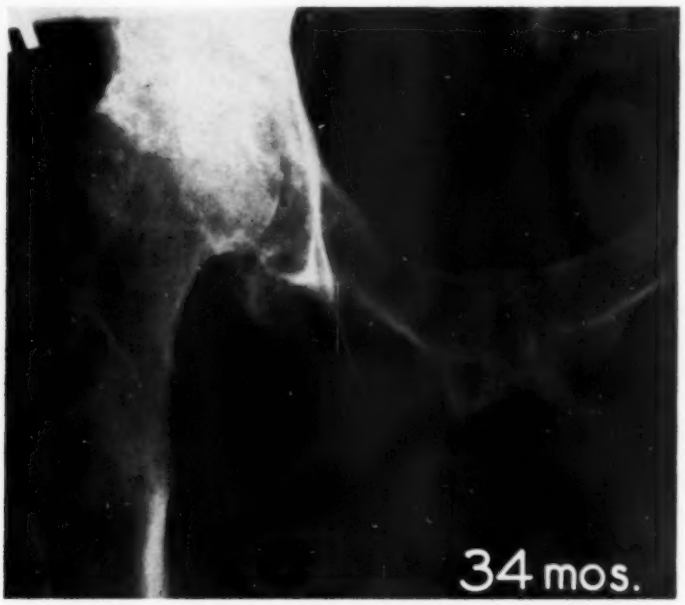

Fig. 4. Current case, three years postoperatively. Remarkably little advance of joint destruction. Chronic stage with osteoblastic lesion and thickening of femoral neck more apparent. Pain on weight-bearing and nearly complete fixation of joint.

The secondary contributing cause is surgical trauma, which activates infection and starts the spread.

PATHOLOGY

The 10 biopsies previously recorded (5) are regarded by this writer as firm ground for the belief that these lesions, whether of pubes, ischia, or hip, are osteomyelitis. Most authors seem to disagree. Such designations as "osteitis," "panosteitis," and "pyogenic granulation tissue" need not confuse the question. The histologic picture of bone erosion and fragmentation, pus, and cartilage necrosis makes it difficult to deny an osteomyelitis. The clinical and roentgen signs add further support to this view.

CLINICAL ASPECTS

In the series here collected, the hip lesions were seen only in middle-aged males after prostatectomy. The onset in 1 case occurred at fourteen weeks and in another at nine months postoperatively. In the others, the dates of onset are not stated, but in 1 the duration of disease was reputedly three months, and in another over twenty-four. The total experience indicates a duration of several years before fusion creates relative comfort. In 3 of the 4 cases, the hip lesion was definitely preceded by pubic disease.

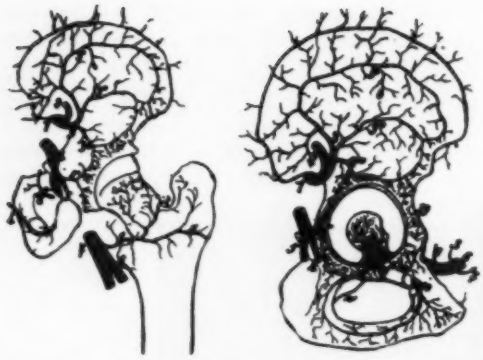

Fig. 5. Posterior and lateral aspects of pubis, ischium, and hip, showing arterial connections of these parts through soft-tissue and bony channels. Venous paths correspond. From Ribet, suggested by Batson.

There is continuous pain in the hip and thigh aggravated by weight-bearing. Progressive limitation of motion to complete fixation, limp, and shortening of the limb appear over months to years. Fever and leukocytosis have been recorded incompletely, but probably exist in the early period to a small degree.

No successful therapy has yet been devised.

ROENTGEN EXAMINATION

On the basis of the two sets of roentgenograms available, the picture is that of a steadily progressive, erosive disease of the articular surface of the femoral head and acetabulum. In several months the joint space becomes narrow and the simultaneous productive and lytic actions extend deeply, until the acetabulum is enlarged and deformed, the femoral head eroded and flattened, and the neck thickened (Figs. 1 to 4). The descriptions (4, 8) of the 2 earlier cases suggest very similar roentgen findings. All available information seems to identify this lesion as pyogenic arthritis.

PROGNOSTICATIONS

1. Although 3 of the 4 cases of arthritis of the hip following operation on the urinary tract have shown severe involvement, future vigilance may result in recognition of more mild examples of the disease. In any event, the postoperative patient having hip pain deserves prompt care, including frequent roentgen examination.

2. Some patients presenting an "idiopathic" hip arthritis may disclose a positive surgical or urinary tract history.

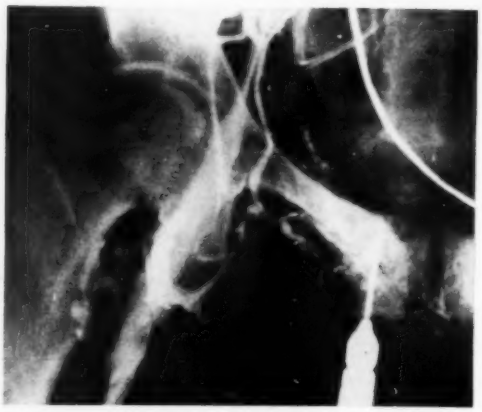

Fig. 6. Transpubic injection of opaque medium in a patient with pelvic tumor. This demonstrates the medium emerging from the veins of the pubis, crossing the symphysis, and extending through the obturator, external iliac, and femoral systems. This confirms the ready connections between inferior pelvis and hip.

3. Evidence is accumulating that the hip lesion is but one link in a disease which extends beyond the pelvic girdle.

SUMMARY

1. In rare instances a destructive arthritis of the hip may follow urinary tract operation, being associated with osteitis pubis. The fourth known case is reported here and the 3 earlier examples are described.

2. The most probable etiology is chronic infection of the urinary tract, activated by surgical trauma.

3. The spread of infection can be explained best by transfer through soft and bony venous paths between the inferior pelvis and the hip.

4. The condition appears to be a purulent arthritis, directly related to the low-grade osteomyelitis of the pubis and ischium.

5. For the future: mild degrees of the disease may be expected; some unexplained

hip lesions may be elucidated; and other infectious bone lesions beyond the pelvis may be linked to the chain of pubic-hip disease.

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SUMARIO

Artritis de la Cadera Consecutiva a Operación en el Aparato Urinario

En raras ocasiones, una operación en el aparato urinario puede ir seguida de artritis destructiva de la cadera, asociándose con osteítis púbica. Preséntase el cuarto caso conocido y se describen los tres casos anteriores.

La etiología más probable es infección crónica del aparato urinario, activada por el traumatismo quirúrgico. La propagación de la infección puede explicarse mejor por su paso a través de vías venosas y blandas y óseas entre la porción inferior de la pelvis y la cadera.

La dolencia parece ser una artritis purulenta, relacionada directamente con una osteomielitis de desarrollo lento que afecta el pubis y el isquion. En el futuro: cabe esperar formas leves de la enfermedad; podrán esclarecerse algunas lesiones inexplicadas de la cadera; y podrán enlazarse con la cadena púbico-coxal de enfermedad otras lesiones infecciosas de los huesos más allá de la pelvis.

Radiating Spicules, a Non-Specific Sign of Bone Disease[1]

OTTO H. GRUNOW, M.D.

IT IS NATURAL for us to believe that the course of a disease follows a set pattern. We are taught in this manner and, moreover, accept the unmistakable example as classical. Likewise, we associate a classical radiographic picture with a specific bone disease. The patterns may become so fixed in our mind that we demand their presence to assure the diagnosis. For this reason alone, it is wise to review our concepts critically so that misconceptions might be corrected in the light of newer experiences.

The more common radiographic evidences of bone tumor, beside destruction, are spiculation (arborization, sunburst, ray formation, sun ray), periosteal lipping (reactive cuff, Codman's triangle), and layering of bone (onionization). Of these, I would like to draw attention primarily to spiculation, although the reactive cuff and onionization are related reactions.

Spiculation is commonly associated with osteosarcoma. A number of major source books (1–7), even in recent editions, emphasize the need and importance of this finding. Its importance, however, was challenged at an early date by Kolodny (8), who found that only 18 per cent of the osteogenic sarcomata listed in the Registry of Bone Sarcoma presented the typical appearance. He also made the pertinent remark: "To the inexperienced surgeon or roentgenologist few roentgenograms will suggest the diagnosis, osteogenic sarcoma, unless there is the known fanlike structure or at least the lipping of the periosteum."

At a later date, Sherwood Moore (9), reviewing the same concepts, wrote: "The fact of the matter is, any of these signs (*i.e.*, arborization, onionization, reactive cuff) can accompany conditions other than bone tumor." Pendergrass, Lafferty and Horn (10) also emphasized the variability of bone disease manifestations. Grout (11) exhibited two instances in which the classical picture of osteogenic sarcoma proved to be associated with a benign lesion. He pleaded that clinical findings be taken into consideration when making diagnoses. Several source books now list exceptions to the general rule (12).

A number of exceptions have come to my attention and these I shall present as a series of cases in which more or less typical spiculations proved to represent some disease other than osteosarcoma.

EWING'S SARCOMA

The "classical" description of Ewing's sarcoma seldom includes spiculation; yet it was seen in 5 of 7 cases studied. In 2 instances it caused confusion in the diagnosis.

CASE I (Figs. 1 and 2): D. A. H., a 5-year-old white male, occasionally complained of pain in his left leg. Three months prior to hospitalization his parents noticed a small, hard swelling on the anterolateral surface of the leg. Physical examination revealed a fusiform, firm, tender mass in the upper left leg, associated with superficial veins and atrophic musculature.The clinical impression was osteogenic sarcoma. The x-ray diagnosis of Ewing's sarcoma was confirmed by microscopic study.

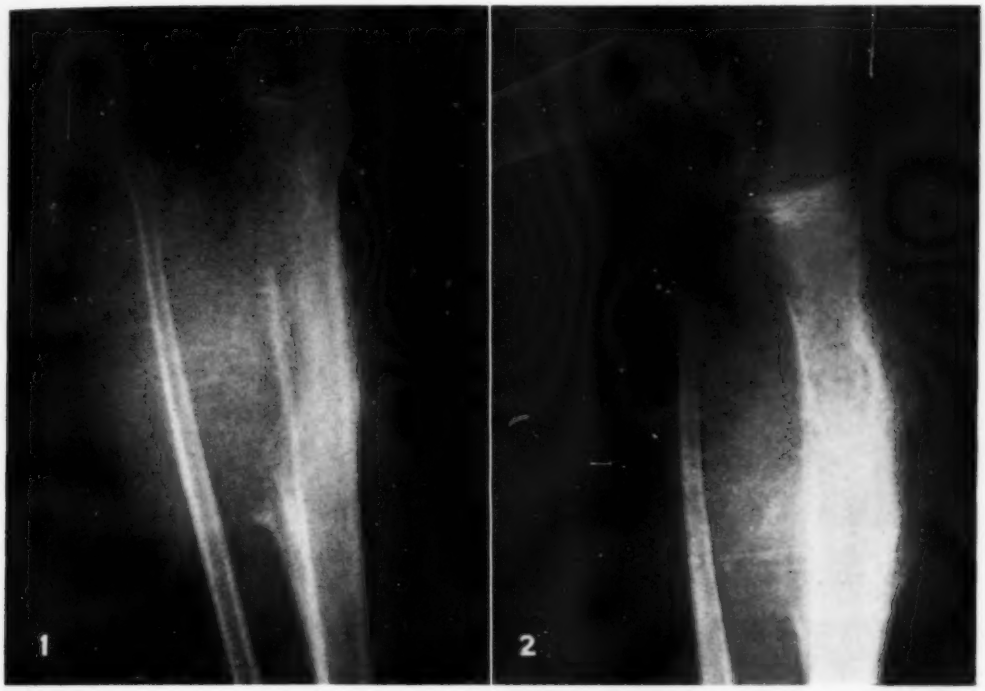
Brunschwig (13) has also described a Ewing's sarcoma with prominent spiculation.

CHONDROSARCOMA

Spiculation is usually not included in the description of chondrosarcoma, yet the following example displayed a prominent sunburst.

CASE II (Fig. 3): L. G. S., a 64-year-old white male, had experienced severe pain in the left shoulder ten years earlier. A diagnosis of chondrosarcoma was made; the involved humerus was resected, and a fibular graft introduced. Eight months prior

[1] Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.



Figs. 1 and 2. Case I: Ewing's sarcoma displaying prominent spiculation, which suggested osteosarcoma to the clinician. Anteroposterior and lateral views.

to the present examination the graft was fractured, and three months before entry a swelling appeared at the site of the graft. Physical examination revealed a firm, non-tender fusiform mass covered by thin red skin. The extremity was moderately edematous. The arm was amputated. The microscopic diagnosis was chondrosarcoma.

METASTATIC CARCINOMA

Localized bone destruction usually denotes a bony metastasis. Those from breast and prostate may be of an osteoblastic type, but rarely does any metastasis display an overgrowth of bone. Golding (12) states that the rare bone metastases from the alimentary tract usually manifest themselves in unusual forms and cites a bone lesion, indistinguishable from osteogenic sarcoma, whose primary was in the esophagus. Ackerman and del Regato (14) present a tibial lesion metastatic from the sigmoid colon, which had a typical ray pattern.

CASE III (Fig. 4): D. E. W., a 49-year-old white female, experienced pain in the left thigh one and a

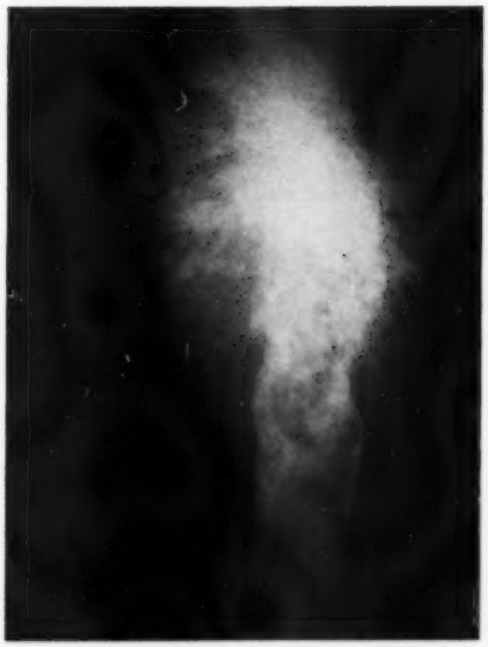


Fig. 3. Case II: Chondrosarcoma very suggestive of osteosarcoma.

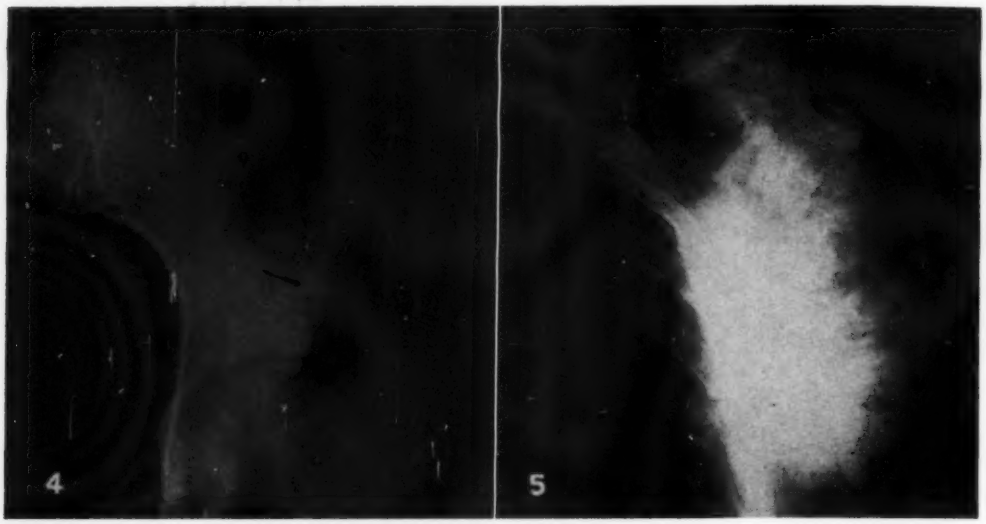


Fig. 4. Case III: Metastatic adenocarcinoma of the pelvis confused with osteosarcoma.
Fig. 5. Case IV: Metastatic prostatic carcinoma originally diagnosed as osteosarcoma.

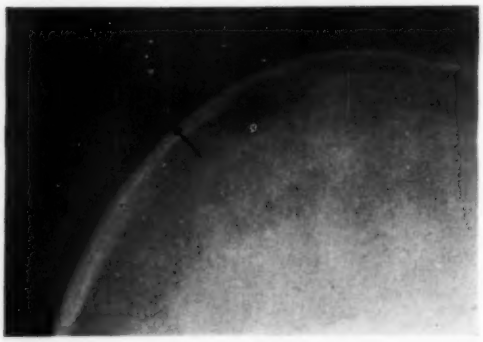


Fig. 6. Case V: Metastatic neuroblastoma with evident spicules in the parietal region. (Courtesy of David Goldring, M.D.)

half years earlier. Roentgenograms of the area were interpreted as osteogenic sarcoma, whereupon deep x-ray therapy was given, without relief of pain or regression of the tumor. No other evidence of malignant disease was detected. Because of unbearable pain, hemipelvectomy was performed. Microscopy revealed a metastatic adenocarcinoma whose original site was not determined.

CASE IV (Fig. 5): Another striking example is seen in the shoulder of a 74-year-old white male whose chief complaint was discomfort in the left shoulder. Clinical studies revealed obvious prostatism but no other evidence of disease. The films of the scapula displayed a prominent bone reaction with a classical ray pattern suggestive of osteosarcoma. Biopsy showed metastatic carcinoma of the prostate. As the result of x-ray therapy and orchiectomy the "sunburst" became blunted. One year later extensive typical osteoblastic bone lesions developed.

Ackerman (15) collected 2 autopsy specimens of metastatic prostatic carcinoma to the ribs which displayed a regular fine comb of spicules. Brunschwig (13) illustrates 2 similar examples and adds 1 of metastasis from the pancreas to the parietal bone.

Coley (16) cites the case of a metastatic teratoma testis which displayed a prominent ray formation in the humerus. Kemp and Williams (17) describe one of the reactions to subperiosteal deposition of myeloid cells in chloroma as a palisade of new bone laid down at right angles to the cortex.

Dyke (18) illustrates the effect of an angioma of the skull and states that spiculation is commonly produced by this tumor. Descriptions of metastatic neuroblastoma in ribs and skull usually include mention of bone spicules.

CASE V (Fig. 6): G. S., a 5-month-old white male, was examined because of hemorrhages about the eyes and the presence of a right abdominal mass. Exploratory laparotomy revealed neuroblastoma in the liver, with a large right retroperi-

toneal mass. The metastatic lesion in the skull displayed the typical ray formation.

MENINGIOMA

Meningioma has also frequently been known to produce a degree of spiculation in the calvarium.

CASE VI (Fig. 7): F. E., a 42-year-old white laborer, complained of a gradually growing lump on the left side of the head, present for three years. Physical examination showed an irregular fixed mass 6 × 7 × 3 cm., located on the left parietal bone. Excision revealed a meningioma depressing the brain and intimately associated with large venous channels.

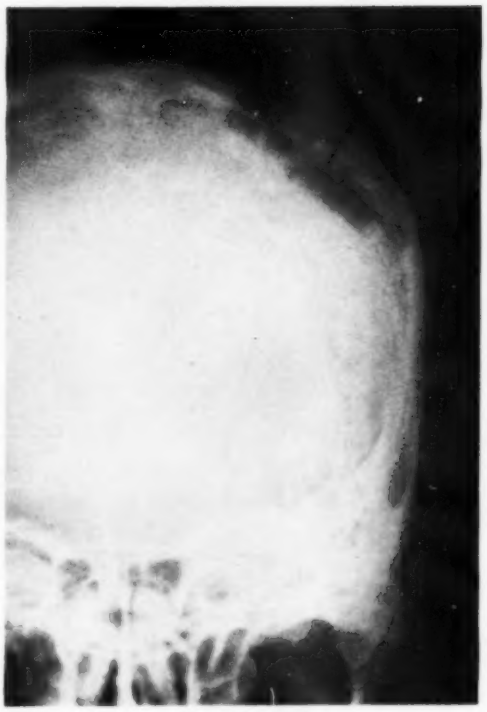


Fig. 7. Case VI: Meningioma of the calvarium with evident spiculation.

SYPHILIS

Spicule formation in bone infections is uncommon. Syphilis on several occasions confused the issue with a periostitis indistinguishable from sarcoma.

CASE VII (Fig. 8): B. S. E., a white female four and a half years old, had an angry looking undermined ulcer on the dorsum and posterolateral portion of the right foot. Of lesser significance to the patient was an intermittent swelling of the right leg, present from seven to ten months. Radiographs of the leg suggested a diagnosis of sarcoma, but a positive Kahn reaction resolved the problem.

Ackerman and del Regato (14) describe a lesion in the tibia for which amputation was considered until a similar process of lesser degree was discovered in the opposite leg and a positive Kahn reaction indicated the correct diagnosis.

CHRONIC OSTEOMYELITIS

CASE VIII (Fig. 9): C. P. M., a 38-year-old white male, gave a history of a soreness in the left leg two years previously, which had subsided completely after two days. Three months prior to examination he had been chilled by wet clothes. The following morning the lower leg was swollen and hot. The swelling gradually increased and some pain was noticed during the day. One week before examination chills and fever developed and night pain became prominent. Osteotomy revealed a chronic osteomyelitis from which hemolytic *Staphylococcus aureus* was cultured.

CHRONIC HEMOLYTIC ANEMIAS

Of added interest are the chronic hemolytic anemias. Descriptions of the bone changes in the skull have often included spiculation. The erythroblastic type produces the most prominent, sickle-cell less, and the familial hemolytic type the least ray formation. Our attention has been called to a supposed difference between the manifestations of meningioma and the anemias. In the latter cases the outer table is said to be intact but osteoporotic. The spicules are thought to represent enlarged diploe. It may be, however, that the structures thought to be the outer table are actually the raised pericranium.

DISCUSSION

The spicules we have seen are variable in character, being perpendicular to the cortex, slightly angulated, or flowing. They may be short or long, fine or coarse, few in number or forming a well developed palisade. They may simulate a fine comb and have been called "groomed whiskers." Besides radiating outward, they may radiate inward into the medullary canal.

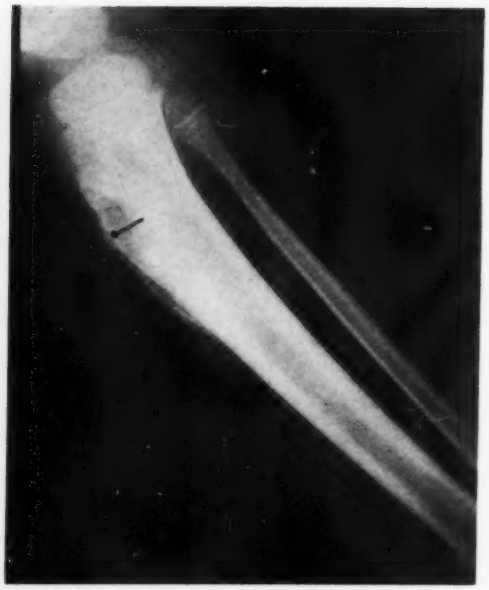


Fig. 8. Case VII: Congenital syphilis, initially considered to be osteosarcoma.

It is possible that one of the stages of repair that follow elevation of the periosteum is the formation of spicules and that this stage is usually obscured by the rapidity with which the reparative process progresses. This is probably true in fractures and most likely in bone infection. When repair is continuously disturbed, as in slowly growing tumors, the spicules have a chance to enlarge and become coarse.

Nineteen years ago Brunschwig and Harmon (19) reported the results of a significant study. They placed fragments of a transplantable non-osteogenic rat sarcoma in the medullary cavity of the long bones of the rat. Growth of the tumor produced a ray pattern which was indistinguishable from that found in osteosarcoma. The pattern developed regularly up to the point where the tumor broke through and destroyed the normal reparative process. Microscopy revealed that the spicules were not the result of tumor, *per se*, nor were they formed by metaplastic tumor tissue. Rather they were of periosteal origin, showing varying degrees of maturity, with the more mature near the cortex. The spicules, moreover, were closely related to fibrous bands which may have been prolongations of Sharpey's fibers. Since the periosteum is elevated to a greater degree at the site of extensive growth than near the anchor point, there is

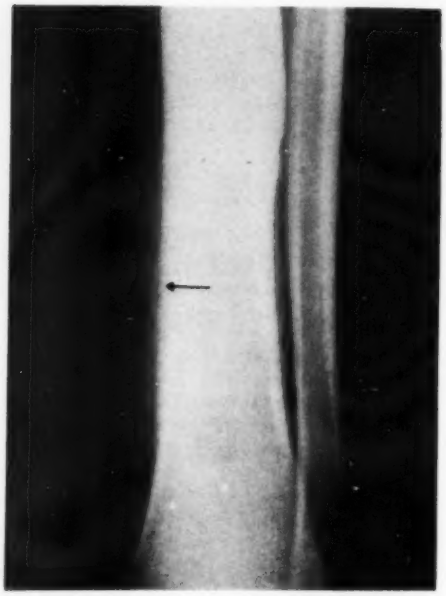


Fig. 9. Case VIII: Chronic osteomyelitis with spicule formation simulating osteosarcoma.

produced a triangle of denser bone, the "reactive triangle." Should the lifting of the periosteum be intermittent in character, with alternating periods of rapid and slow growth and with the addition of absorption, then there may be produced a layering which has frequently been described in Ewing's sarcoma.

SUMMARY

Since spiculation has been described in many diseases other than osteosarcoma and is infrequently seen in that disease, it is reasonable to assume that spiculation should no longer, *per se*, be considered as diagnostic evidence of primary bone tumor.

Like the reactive cuff, spiculation is primarily an attempt at repair by a peri-

osteum which is inexorably elevated by an expanding process, be it tumor, infection, or hyperplasia of the marrow. The pattern is the result of an attempt to follow either elongating Sharpey's fibers or the elevation of small nutrient vessels.

Spiculation, therefore, represents a nonspecific manifestation of bone disease.

NOTE: I wish to acknowledge with gratitude the help, inspiration, and interest which Dr. Ackerman showed in the writing of this paper. I am deeply indebted to Mallinckrodt Institute of Radiology of Washington University School of Medicine, St. Louis, for the use of their films and case histories.

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SUMARIO

Espículas Radiadas, Manifestación Anespecífica de Osteopatía

Habiendo sido descrita la espiculación o formación de espigas en muchas enfermedades distintas del osteosarcoma y sido observada raramente en esta dolencia, no debe ser ya más considerada, *per se*, como signo diagnóstico de tumor óseo primario.

Lo mismo que el brazal reactivo, la espiculación es primordialmente una tentativa de regeneración por un periostio que se encuentra inexorablemente elevado por un proceso expansivo, ya sea tumor, infección o hiperplasia de la médula ósea. El patrón formado es la consecuencia de una tentativa para seguir la misma vía, bien alargando las fibras de Sharpey o elevando pequeños vasos nutrientes. La espiculación representa, por lo tanto, una manifestación anespecífica de afección ósea.

Describense casos de sarcoma de Ewing, condrosarcoma, metástasis carcinomatosa, meningioma, sífilis y osteomielitis crónica, todos los cuales revelaron espiculación. Se ha descrito un hallazgo semejante en las anemias hemolíticas crónicas.

Familial Metaphyseal Dysplasia[1]

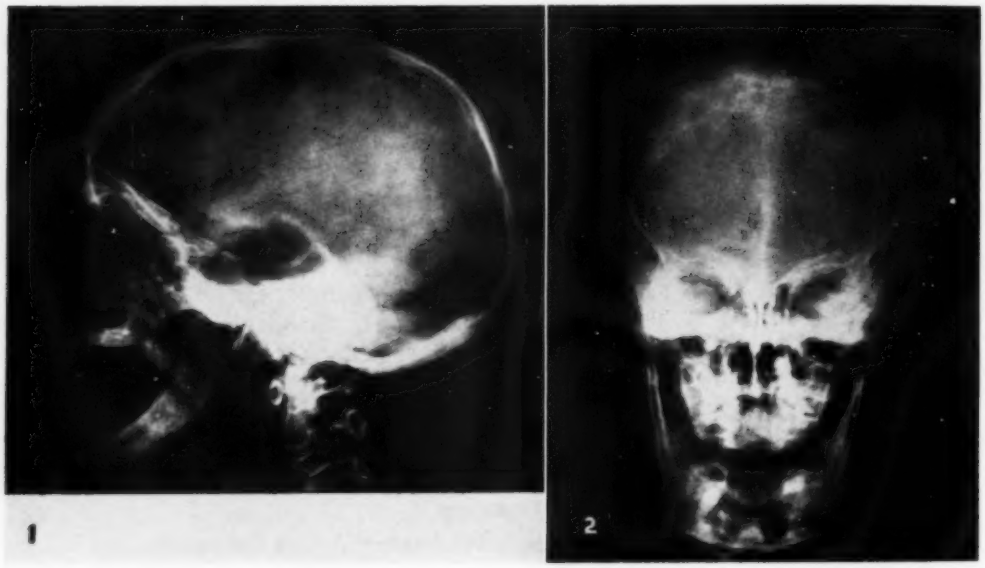
HAROLD FELD, M.D., ROBERT A. SWITZER, M.D., MORRIS W. DEXTER, M.D., and EDWARD M. LANGER, M.D.[2]

THIS PAPER REPORTS two cases of familial metaphyseal dysplasia involving a brother and sister. These cases are being added to the 4 cases previously reported in the literature.

REPORT OF CASES

CASE I: A 53-year-old white male, a laborer, was first seen at Bay Pines Veterans Administration Center on Aug. 10, 1953, with osseous lesions discovered elsewhere roentgenographically and attributed to Gaucher's disease. He had been completely asymptomatic until 1942, when he began to experience intermittent pain in the knees, back, right shoulder, and proximal interphalangeal joints of both hands. He also had some swelling of the right knee. This was thought to represent an osteoarthritis. Roentgenograms taken in 1943, however, showed widening of the proximal and distal ends of the tibia, and at that time a diagnosis of Albers-Schönberg disease was made. In 1946, these bony changes were again noted, and it was at this time that the diagnosis of Gaucher's disease was made, though a biopsy taken from the right tibia the year before had been negative for that condition.

The patient had had the usual childhood diseases but gave no history of rickets, scurvy, or syphilis. He had had no headaches, visual disturbances, or other abnormalities. In 1942, he had received surgical treatment for Dupuytren's contracture of the right hand. He was unaware of the existence of bony abnormalities in other members of his family. Except for one sister, he had been out of contact with his 6 sisters and 2 brothers for many years.



Figs. 1 and 2. Case I: Skull roentgenograms showing narrowing of the base in lateral diameter, small sella turcica, and thickened dorsum sellae. The paranasal sinuses are not pneumatized, or only partially so. The ethmoid and maxillary cells are hypoplastic, and there is failure of development of the air cells in the temporal bone.

Rectal examination revealed some hypertrophy of the prostate. Examination of the skeletal system disclosed palpable widening of all long bones, including the phalanges at their metaphyseal ends. There was no impairment of active or passive movements. The gait was normal and there was no evidence of abnormal length of the extremities

[1] From the VA Center, Bay Pines, Fla. Accepted for publication in July 1954.
[2] Sarasota, Fla.

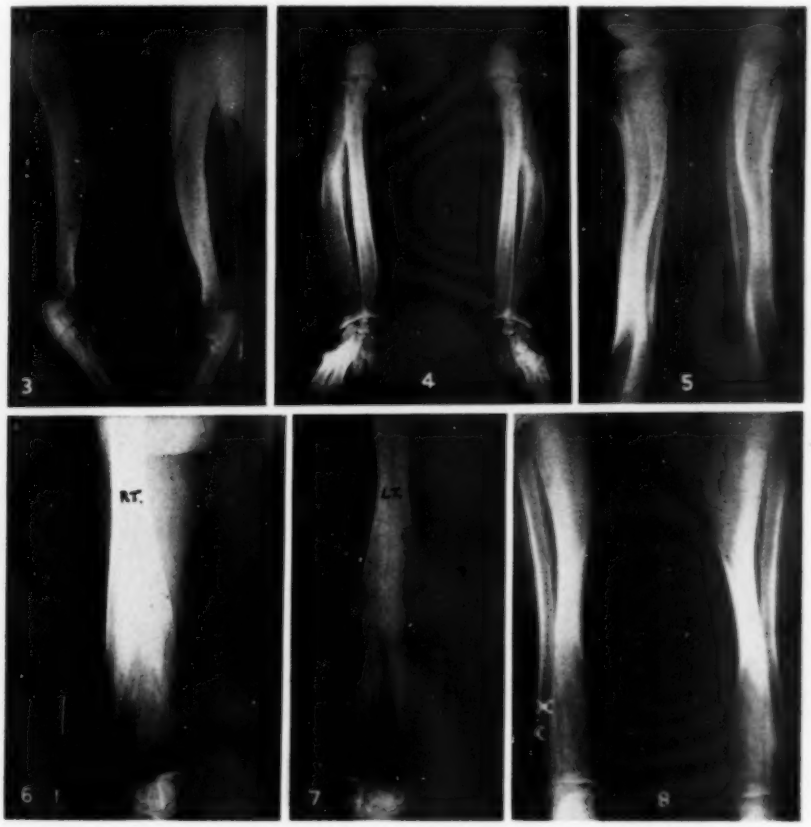
The head was normal except for some prominence of the temporal bones.

Serologic tests, blood counts, and urinalysis were normal. Serum calcium was 9.98 mg. per 100 c.c.; inorganic phosphorus, 2.54 mg. per 100 c.c.; alkaline phosphatase 2.5 units.

Roentgen Findings: The *skull* (Figs. 1 and 2) was narrowed at its base in the transverse diameter. The sella turcica was small and there was some thickening of the posterior clinoids. Except for the maxillary sinuses and a few anterior and middle ethmoid cells, there was agenesis of almost all the paranasal sinuses. The maxillary sinuses and anterior and middle ethmoid cells were hypoplastic.

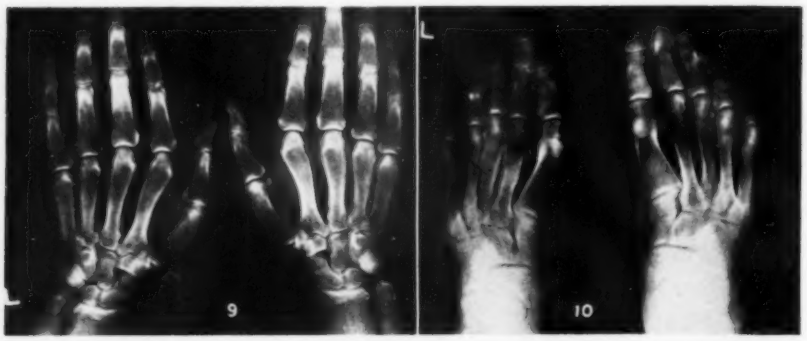
The *long bones, hands, and feet* are shown in Figures 3–10, 14, and 15. The *humeri* were moderately thickened, club-shaped proximally, and curved laterally. Only the proximal two-thirds were involved. The cortex was markedly thinned, while the normal trabecular pattern of the medullary portions of the bones was replaced by a homogeneous ground-glass appearance.

The bones about both elbows appeared normal, but the distal two-thirds of both *radii* and *ulnae* again showed the characteristic thickening and club-shaped appearance. There were thinning of the cortex and a ground-glass appearance of the medulla.



Figs. 3–8. Case I: The long bones. The proximal humerus, proximal and distal thirds of the tibiae and distal femora are widened and club-shaped. The distal halves of both radii and ulnae show a similar appearance. Note the narrow cortex and the ground-glass appearance of the medullary portions of the bones. The humeri are bowed laterally. Fine transverse lines are numerous in all the long bones of the lower extremities. Both radii are similarly involved.

The medullary portions of the *carpal bones* also showed a homogeneous ground-glass appearance and the bones appeared slightly enlarged. The distal ends of the shafts and heads of the second through the fifth metacarpal were widened, while the proximal portions of the first metacarpal and the proximal phalanges of each hand showed thickening of the medulla and thinning of the cortex, causing a widening of the shafts. There was absence of the normal trabecular pattern, as already



Figs. 9 and 10. Case I: Hands and feet. The carpal and tarsal bones show a ground-glass appearance and are slightly enlarged. The distal ends of the shafts and heads of the second through the fourth metacarpal bone are widened, while proximal portions of the first metacarpals and proximal phalanges show a similar appearance. The metatarsals and phalanges of the feet show similar changes. Note evidence of an old healed fracture of the second metatarsal of the left foot.

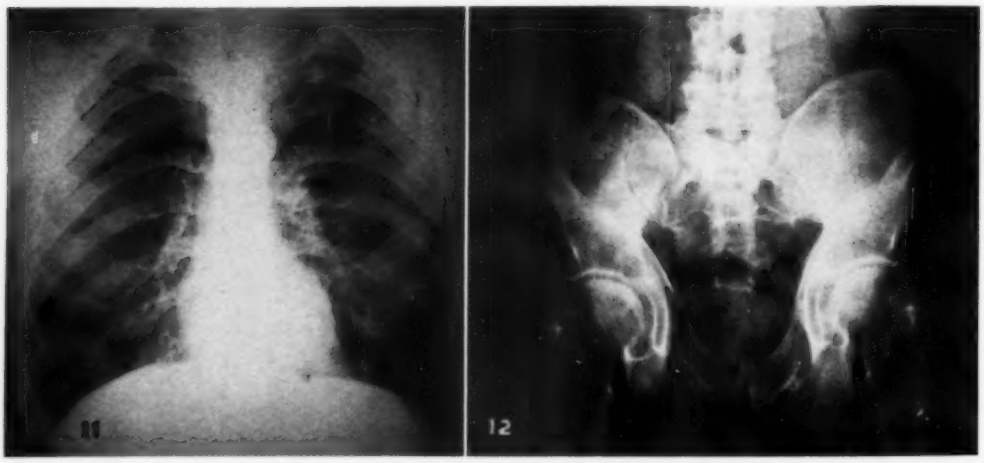


Fig. 11. Case I: Chest, showing widening of anterior ribs and of the medial two-thirds of both clavicles.
Fig. 12. Case I: Pelvis. There is narrowing of the transverse diameter, and the bones show the same ground-glass appearance seen elsewhere. The upper femora show coxa valga deformity and the femoral necks are widened, as are the pubic bones and ischia.

described. The heads of all the phalanges, including the terminal tufts of both hands, were uninvolved.

The *femora* were widened at their distal ends, giving them an Erlenmeyer flask appearance such as is often seen in Gaucher's disease. The upper femora showed coxa valga deformities and there was some thickening of the femoral necks. Here again there was thinning of the cortex and a ground-glass appearance of the medulla.

The proximal and distal thirds of both *tibiae* and *fibulae* were widened and club-shaped at their proximal and distal thirds, and the appearance of the medullary and cortical portions was typical. In addition, the tibiae were S-shaped, indicating probable osteomalacia. There were numerous transverse growth lines in the long bones of both lower extremities and in both radii.

The *tarsal bones* showed the distinctive ground-glass appearance instead of the normal trabecular pattern and were only slightly enlarged. The second through the fifth proximal metatarsals, bilaterally, and the proximal halves of the proximal phalanges of both feet showed the typical loss of normal trabeculations. In addition, there was evidence of an old fracture of the second metatarsal of the left foot with good bony union and good callus. There was no history of previous injury to this foot.

The anterior thirds of all the *ribs* (Fig. 11) showed

the thickening and other findings characteristic of the condition, while the medial two-thirds of both *clavicles* and the acromion processes of both *scapulae* were similarly involved.

The *pelvis* (Fig. 12) was narrowed in the transverse diameter, giving the pelvic inlet a pear-shaped appearance. Both the pubic bones and ischia were widened bilaterally and showed the typical ground-glass appearance.

The *lumbar spine* (Fig. 13) showed some lengthening of the anteroposterior diameter of the vertebral bodies.

Hospital Course: Symptoms referable to the skeletal system were as described above. On Aug. 18, a fragment of bone was removed from the distal portion of the right fibula for gross and microscopic examination. The surgeon's note was as follows: "There was no abnormal pathology noted about the periosteum or cortical portion of the fibula. The fibula was considerably broader than normal. The exact width, however, was not measured. As soon as the cortical portion of the fibula was removed, the underlying cancellous bone was of a whitish-gray color, seemed to be firmly packed, and there was no evidence of any cavitation or bleeding." The microscopic diagnosis was "bone marrow showing no diagnostic lesions." The bone lesion healed well. Bone marrow aspiration done previously, Aug. 11, 1953, likewise showed no abnormality.

CASE II: A 46-year-old white female, sister of the patient just described, was unaware of any skeletal abnormalities until they were called to her attention on a routine x-ray examination. She showed some widening or thickening of the extremities about the metaphyseal ends of bones. Her menses were regular and she had had no pregnancies. In 1934 she was treated for fracture of the left hip. Since March 1948, she had experienced intermittent bouts of diarrhea, associated with chills, fever, and skin lesions similar to erythema nodosum. Barium enema studies demonstrated ulcerations and some irregularity of the transverse colon and upper descending colon. Despite medical treatment, the patient continued for a time to have symptoms and lose weight. Laboratory studies showed normal blood counts and serology. None of the symptoms described could be directly associated with the skeletal abnormalities.

Roentgen Findings: Unfortunately, roentgenograms of only the left upper and lower extremities, skull, and pelvis could be obtained. These showed the same characteristic findings as Case I (Figs. 14–18), with one exception. There was bilateral intrapelvic protrusion of the acetabula (Otto pelvis), suggesting osteomalacia of the acetabulum. There was also evidence of an old healed fracture of the left femoral neck.

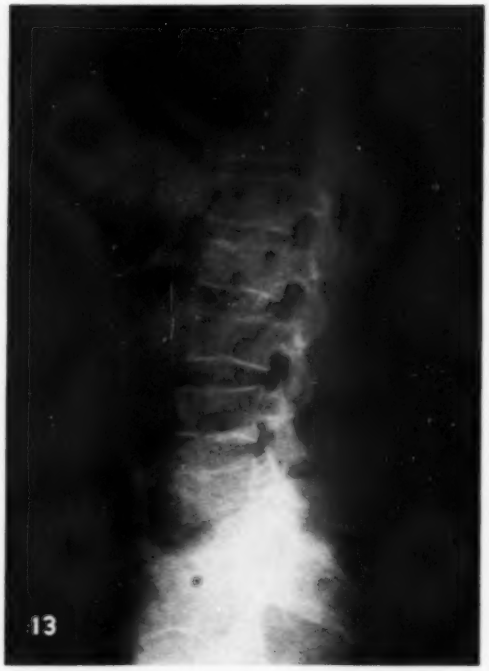


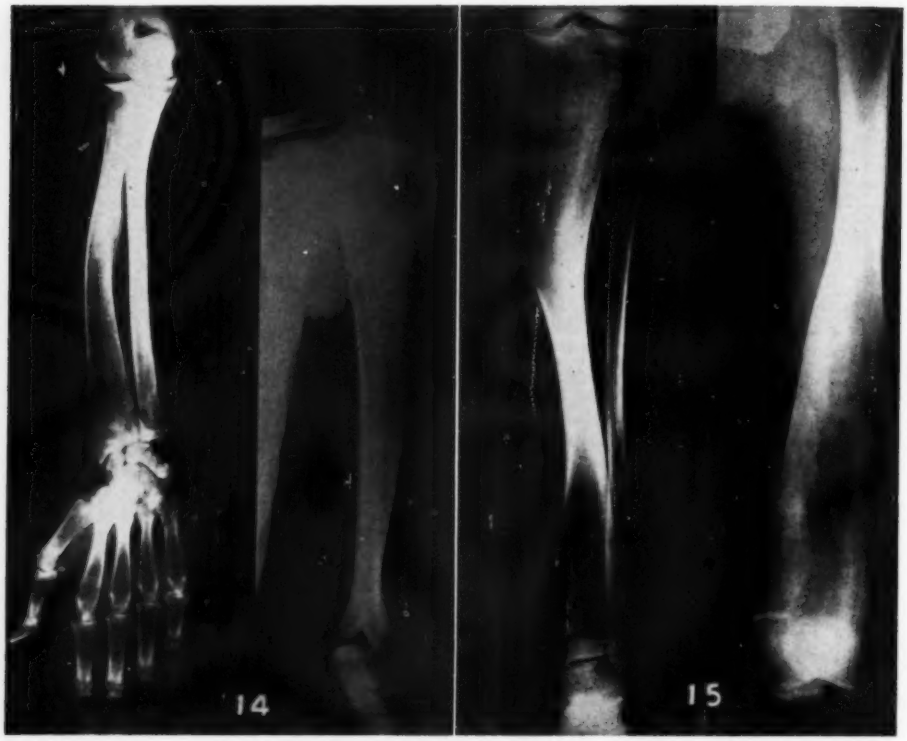
Fig. 13. Case I: Lumbar spine, showing some lengthening of the vertebral bodies in the anteroposterior diameters.

DISCUSSION

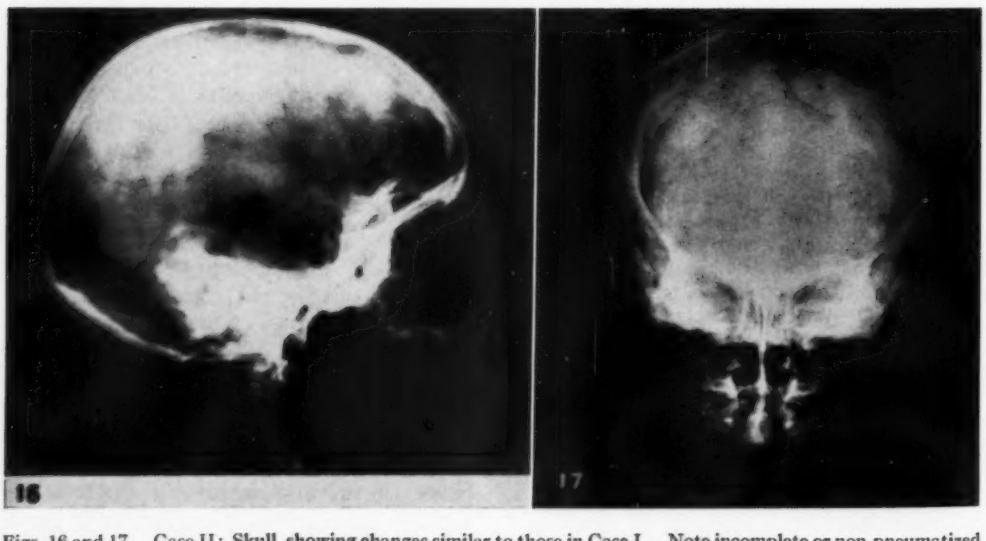
In 1931, Edwin Pyle (3) described a case in a five-year-old boy similar to those reported above. He attributed the abnormalities observed to a disturbance of growth of the involved bones. His patient had marked genu valgum deformity, and a double osteotomy was performed for that condition. At operation, it was found that the bone was very soft and that the chisel could be forced through it without the use of a mallet.

Bakwin and Krida (1), in 1937, studied the patient described by Pyle and added an account of the patient's sister. Roentgen study of bones of the parents of these siblings was negative. The findings in the brother and sister indicated that the lesion involved principally the metaphyseal ends of tubular bones, with characteristic and symmetrical distribution. Because of its appearance in siblings, the authors assumed the condition to be familial, and were the first to employ the name "familial metaphyseal dysplasia."

At the fourth Inter-American Congress



Figs. 14 and 15. Case II: Left upper and lower extremities, showing the same changes as Case I.



Figs. 16 and 17. Case II: Skull, showing changes similar to those in Case I. Note incomplete or non-pneumatized paranasal sinuses and mastoid cells. The sella turcica is small, and there is thickening of the bone about the sella.

of Radiology, in 1952, Hermel, Gershon-Cohen, and Jones (2) presented the third and fourth cases of familial metaphyseal dysplasia in a thirty-three-year-old male and his thirty-four-year-old sister. The bony changes were similar to those found by Bakwin and Krida. In addition, growth lines were described, especially prominent in the long bones of the thighs, legs, and forearms. There was no pneumatization of the temporal bones and paranasal sinuses, except for vestigial maxillary and anterior ethmoid cells. (Bakwin and Krida made no mention of abnormality of paranasal sinuses or temporal bones.) Hermel and his associates concluded that the disease was primarily a dysplasia of the metaphyseal side of the long bones, but they could not explain the absence of pneumatization of the temporal bones and almost complete agenesis of the paranasal sinuses.

The roentgen findings in our Case I were very similar to those of Hermel, Gershon-Cohen, and Jones, with the following exceptions: 1. The transverse diameter of the base of the skull in our case was decreased. 2. There was a thickening of the dorsum sellae, and the sella turcica appeared small. 3. The pelvis showed a decrease in the transverse diameter of the inlet, giving it a pear-shaped appearance. 4. The pubic bones and ischia were widened and showed the characteristic cortical thinning. 5. There was slight increase in the anteroposterior diameter of the lumbar vertebrae. 6. Thickening of the femoral necks with bilateral coxa valga deformities were also noted. In addition, our Case II showed bilateral intrapelvic protrusion of the acetabula (Otto pelvis). These findings have not been described previously. Unfortunately, the immediate family and relatives of these siblings were not available for examination.

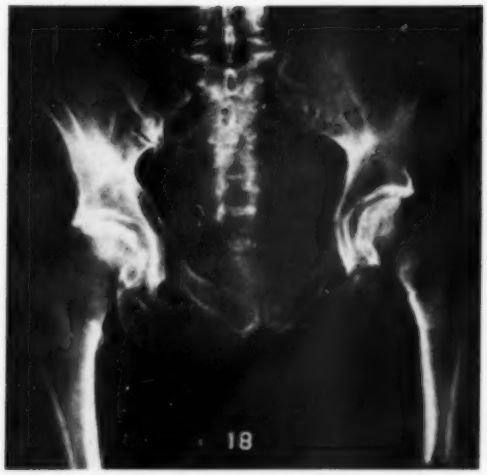


Fig. 18. Case II: Pelvis. There is moderate bilateral intrapelvic protrusion of the acetabula; also, evidence of an old healed fracture of the neck of the left femur. Other changes are similar to those in Case I.

SUMMARY

Two cases of familial metaphyseal dysplasia are added to the 4 previously published. As in the earlier cases, a brother and sister were involved. While the extremities in our patients did not appear elongated, they were definitely widened, especially at the metaphyseal ends. This characteristic widening of the metaphyseal ends of bones, with cortical narrowing and a ground-glass appearance of the medullary portions, together with hypoplasia or aplasia of the paranasal sinuses and the cells in the temporal bones, are discussed. In addition, our cases presented certain findings not previously reported. There was decrease in the transverse diameter of the base of the skull and the transverse diameter of the pelvis. Case I also showed widening of the ischia and pubic bones and thickening of the dorsum sellae, with decrease in size of the sella turcica, and in Case II there was intrapelvic protrusion of the acetabula. Finally, there was thickening of the femoral necks, with bilateral coxa valga deformities and increase in the anteroposterior diameters of the lumbar vertebrae.

Familial metaphyseal dysplasia produces a unique and characteristic appearance of the bones and should not be difficult to differentiate from other conditions.

NOTE: Since this paper was accepted for publication, 2 more cases of familial metaphyseal dysplasia have been recorded by C. Komins (Brit. J. Radiol. **27:** 670–675, December 1954).

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SUMARIO

Displasia Metafisaria Familiar

A los 4 cas ya publicados, agréganse ahora 2 más de displasia metafisaria familiar. Lo mismo que en los casos anteriores, figuran en éstos un hermano y una hermana. Aunque los miembros no parecían estar alargados, se hallaban netamente ensanchados, sobre todo en los extremos de las metáfisis. Este típica dilatación metafisaria va unida a estrechamiento de la corteza y aspecto semitransparente de las porciones medulares de los huesos, junto con hipoplasia o aplasia de los senos paranasales y las células de los huesos temporales. Además, se observaron varios hallazgos, no descritos hasta ahora. Había aumento del diámetro transverso de la base del cráneo y del diámetro transveral de la pelvis. Un caso revelaba además dilatación de los huesos isquion y pubis y engrosamiento del dorso de la silla turca, con disminución del tamaño de la última. Por fin, había espesamiento de los cuellos de los fémures, con deformidades bilaterales en coxa valga y aumento de los diámetros anteroposteriores de las vértebras lumbares. Esta afección imprime un aspecto único y típico a los huesos y no debe ser difícil diferenciarla de otras dolencias.

Chondroectodermal Dysplasia (Ellis-van Creveld Disease)[1]

A Case Report

JAY M. CHAUSS, M.D.

ELLIS AND van Creveld (1), in 1940, described 2 patients with the following congenital anomalies: ectodermal dysplasia affecting hair, teeth, and nails; polydactyly; chondrodysplasia; and congenital heart disease. They included, also, an account of a third patient, previously described by McIntosh (2), who showed all the characteristics of the other 2 cases except for congenital heart disease. In all 3 patients the tubular bones were short and thick. Dwarfism was due to the shortening of the legs; the trunk was of normal length.

A recent paper by Caffey (3) again calls attention to this syndrome, with an excellent account of the findings in 2 new cases and a further report, after fifteen years, of Ellis and van Creveld's third case. As constant findings in this condition, Caffey lists: hypoplasia of the teeth and nails; progressive shortening distalward of the bones in the arms and legs; bilateral manual polydactylism and polymetacarpalism; synmetacarpalism; bilateral fusion of the capitate and hamate bones; retarded maturation of the primary ossification centers in the epiphyseal cartilages; characteristic deformities in the proximal ends of the tibiae, proximal ends of the ulnae, and distal ends of the radii. The following features are inconstant: alopecia, fusion of the upper lip and its gum, congenital malformation of the heart, dislocation of the heads of the radii, retarded maturation of the manual sesamoids, polydactylism and syndactylism in the feet, and polymetatarsalism.

In no instance of this syndrome has there been described any disturbance of the sweat glands. Mental retardation has not been observed. There have been no known malformations in other members of the patients' families. The parents of 2 of Ellis and van Creveld's patients were first cousins, but there has been no consanguinity in the other 3 cases previously described. The etiology of the condition is obscure, and there is nothing to suggest an hereditary factor.

Keizer and Schilder (4) recently described a patient with achondroplasia, ectodermal dysplasia, interventricular septal defect, and symptoms of slight thyrotoxicosis, but the most characteristic skeletal features of the Ellis-van Creveld syndrome were lacking.

Mino, Mino, and Livingstone (5), reviewing the literature, found sixteen papers and at least a hundred cases of associated nail and skeletal anomalies, many of which were hereditary. It would seem, therefore, that while the association of ectodermal dysplasia, particularly of the nails, with skeletal anomalies is not too unusual, the combination heretofore described as Ellis-van Creveld disease is rare and constitutes a distinct entity.

The following is a description of a sixth case.

P. A., a female infant, was born on April 10, 1954, after an uneventful pregnancy and uncomplicated vaginal delivery. The parents were of Polish-American extraction, thirty-five and thirty-three years old. There was no consanguinity. Four previous children were all living and without any malformations. There was no history of any congenital defect in the family of either parent.

The child showed normal color and responses at birth. The birth weight was 7 pounds, 14 ounces. The crown-heel length was 46 cm., the crown-umbilicus length 28 cm., the head circumference 32 cm., the chest circumference 30 cm., and the abdominal circumference 30 cm. It was apparent that the extremities were short in proportion to the trunk. The hair was not abnormal. The upper lip and upper gum were fused, and the usual sulcus between them was obliterated. The upper and lower gums showed irregular ridges and grooves. Examination of the lungs was negative. The heart

[1] From the Department of Radiology, St. Francis Hospital, Olean, N. Y. Accepted for publication in August 1954. Autopsy findings added subsequently.

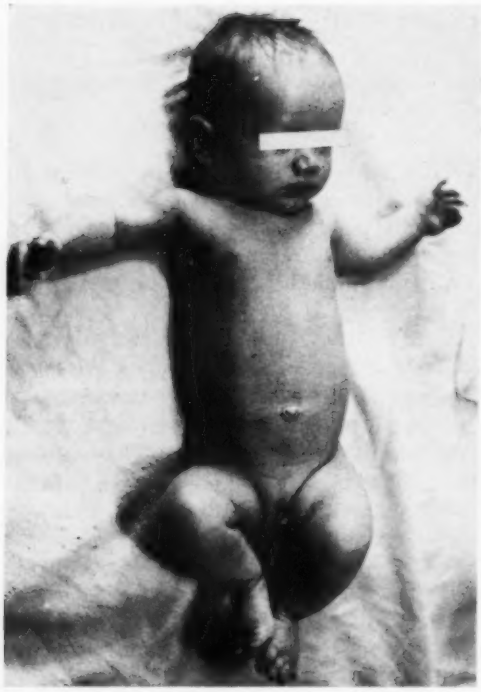

Fig. 1. Photograph of the patient at two months, showing shortened extremities and normal trunk. The hair is normal in quantity and quality.

Fig 2. The left hand at two months, showing the small, deformed nails. The sixth finger was amputated at four days of age.

rate was rapid, 140 per minute; no murmur was audible. A small sixth finger was present on each hand, but there were only five toes on each foot. The nails of the hands and feet were hypoplastic and deformed. Blood Wassermann and urine examinations were negative.

At the age of four days, the sixth digit of each hand was amputated. The child was discharged from the hospital on the seventh day of life. At the age of two months she weighed nine pounds ten ounces, and the photographs reproduced in Figures 1–3 were made.

Roentgenographic studies were done three days after birth. The skull and entire spine, as well as both feet, were normal. No abnormality was seen in the chest, and the heart appeared normal in size and outline. The bones of the extremities were all shortened; the measurements were as follows: humeral shafts 49 mm., ulnae 45 mm., radii 39 mm., femora 64 mm., tibiae 48 mm., and fibulae 39 mm. A supernumerary finger was present on each hand. There were two phalanges on each of these fingers, and the sixth metacarpals

Fig. 3. The mouth at two months. Note the ridges and grooves of the gums and the fusion of the upper lip and gum, with obliteration of the usual sulcus. →

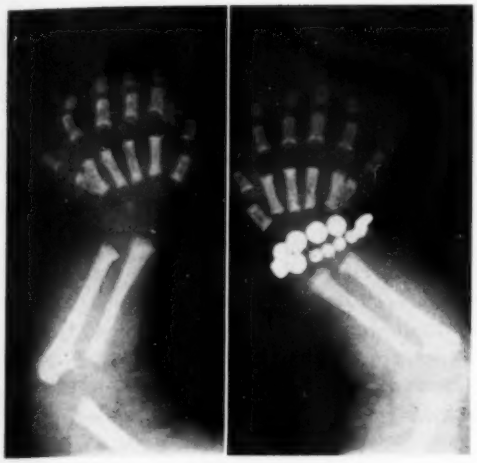

Fig. 4. Radiographs of the hands and forearms at three days of age. There is side-to-side fusion of the fifth and sixth metacarpals. The radial aspects of the fifth metacarpals are concave. Two phalanges are present in each sixth digit. The bones are short and thick, with progressive shortening distally. Note the slight cupping and irregularity of the distal humeral, radial, ulnar, and proximal metacarpal and phalangeal metaphyses.

at the distal ends of the humeri and to a lesser extent at the distal ends of the radii and ulnae and at the proximal ends of the metacarpals and phalanges. Irregularity and cupping were also seen in the metaphyses forming the acetabula (Fig. 5). There was a somewhat premature appearance of the capital epiphyses of the femora. The proximal ends of the tibiae were widened and showed a tendency toward peaking (Fig. 6). The proximal epiphyses of the tibiae were not yet present but would have been expected to appear in an ectopic medial position, which is usual for this syndrome.

The child was not seen, medically, from the time of her discharge from the hospital after birth until the age of twenty-nine weeks. At that time she was cyanotic and dyspneic, with generalized anasarca. A loud systolic murmur was audible over the entire precordium. She was not hospitalized, and death occurred two days later, Nov. 1, 1954.

Postmortem examination was performed by Dr. Leo D. Moss. His description of the heart is as follows: "The pericardial sac contains a slightly increased amount of clear straw-colored fluid. The heart is enlarged and weighs 76 gm. The pericardial surfaces are smooth. Upon opening, the heart is found to have only one large auricle, without any remnants of an interauricular septum whatsoever. The openings of the inferior and su-

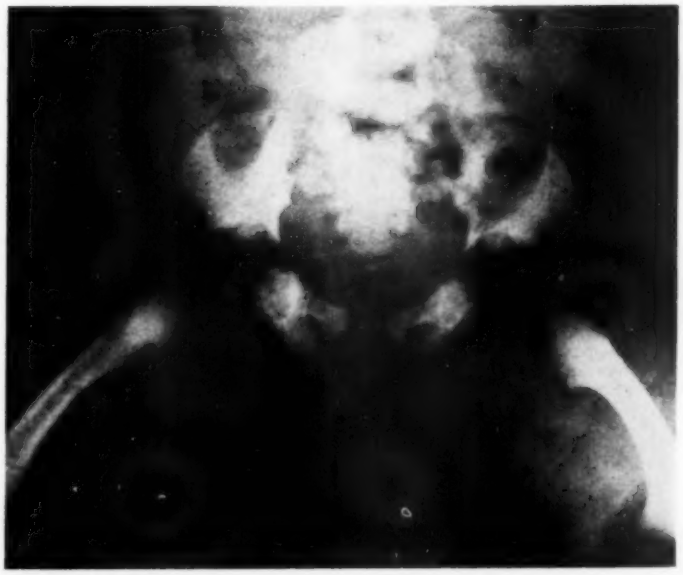

Fig. 5. The acetabula at three days. The metaphyses forming the acetabula are cupped and irregular. The epiphyses of the femoral heads have already appeared.

were fused to the fifth. The radial aspects of the fifth metacarpals were concave (Fig. 4). There were slight irregularity and cupping of the ends of several of the tubular bones. This was noticeable

perior venae cavae, as well as the opening of the pulmonary veins, are present and apparently normal in location. The endocardium of the upper middle posterior portion of this single auricle is grayish

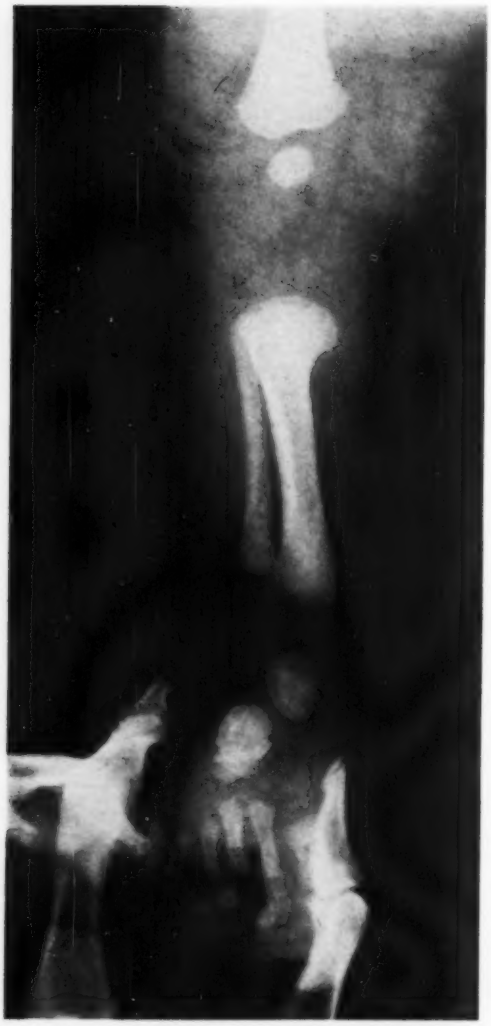

Fig. 6. The right leg at three days. The bones are short and thick, with broadening and slight peaking of the proximal end of the tibia.

white and obviously thickened. There is a small ridge-like structure present approximately 1 cm. above the mitral ring in the lateral aspect of the side of the single auricle. This ridge-like structure measures only about 2 cm. in length and up to 2 mm. in height. In addition, the heart contains two ventricles. There is marked dilatation of all three cardiac chambers. The wall of the right ventricle is somewhat hypertrophied and measures up to 4 mm. in thickness. The tricuspid valve leaflets are of normal configuration. The wall of the left ventricle measures up to 7 mm. in thickness, and the leaflets of the mitral valve are of normal configuration. The cusps of the pulmonary and aortic valves are perfectly normal. The aorta is not grossly remarkable. The ductus arteriosus is closed. The coronary arteries are grossly normal."

Examination of the lungs showed marked congestion and edema, and a small area of consolidation was present in the right lower lobe. The other visceral findings were not remarkable.

SUMMARY

1. A case of chondroectodermal dysplasia (Ellis-van Creveld disease) is described, being the sixth in the literature. It was recognized shortly after birth. Death occurred at the age of twenty-nine weeks.

2. The most typical features of the syndrome were present in this case, including polydactylism of the hands with synmetacarpalism, progressive distalward shortening of the tubular bones, and hypoplasia of the nails. The teeth were expected to have shown typical dysplasias because of the appearance of the gums. The patient was too young for evaluation of some of the other findings usually seen in the bony structures in this syndrome.

3. Of the inconstant lesions which are sometimes present in Ellis-van Creveld disease, fusion of the upper lip and gum and congenital malformation of the heart were present. This heart malformation consisted of a cor triloculare, biventriculare. Congenital heart disease has thus been present in 4 of the 6 known cases of this syndrome.

ACKNOWLEDGMENT: The author wishes to thank Dr. John Caffey for his assistance in classifying this case.

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SUMARIO

Displasia Condroectodérmica (Enfermedad de Ellis-van Creveld). Presentación de un Caso

Descríbese un caso de displasia condroectodérmica (enfermedad de Ellis-van Creveld), siendo el sexto de la literatura. Reconocido poco después del nacimiento, la muerte sobrevino a la edad de vientinueve semanas.

En este caso existían las características más típica del síndrome, comprendiendo polidactilia de las manos con sinmetacarpalismo, acortamiento distal progresivo de los huesos tubulares e hipoplasia de las uñas. Debido al aspecto de las encías, era de esperar que los dientes habrían mostrado displasias típicas. El enfermo era demasiado joven para poder justipreciar algunos de los otros hallazgos observados habitualmente en los tejidos óseos.

De las lesiones inconstantes que a veces se observan en la enfermedad de Ellis-van Creveld, existían fusión del labio y de la encía superiores y malformación congénita del corazón. Esta malformación cardíaca consistía en corazón trilocular, biventricular. En 4 de los 6 casos conocidos de este síndrome, ha habido, pues, cardiopatía congénita.

Rhabdomyosarcoma of the Nasopharynx[1]

ELMER G. ST. JOHN, M.D., and ZUNG-PAH WOO, M.D.

RHABDOMYOSARCOMA of the nasal cavity often begins as a polypoid growth and may easily be mistaken for nasal polyps. For this reason, it is important that polypoid growths in the nasal cavity occurring in childhood be biopsied.

Weber (17) described the first case of rhabdomyosarcoma in 1854, in the tongue of a twenty-one-year-old man. It was excised but recurred. Pastore, Sahyoun, and Mandeville (11) reported a rhabdomyosarcoma of the maxillary antrum in a forty-six-year old Negro, treated by extensive surgery followed by irradiation, without recurrence after seven years. In the records of Memorial Hospital (New York) Stobbe and Dargeon (14) found 15 cases of embryonal rhabdomyosarcoma of the head and neck in children and adolescents ranging from sixteen months to sixteen years of age. The orbit and region of the internal canthus were the site of the tumor in 4 cases, the tonsil and soft palate in 4 cases, the mastoid and internal ear in 2 cases, with the remaining 5 neoplasms distributed in the regions of the neck, temple, zygoma, and parotid. The mean interval between the onset of symptoms and the time of treatment was three and a half months. Metastases were discovered in the cervical and mediastinal lymph nodes, lungs, pleura, ovaries, peritoneum, vertebral column, femurs, kidney, uterus, pancreas, thyroid, and brain.

Cappell (1) published 2 cases involving the palate. A few examples have been described in the nose (2, 12) and in the epipharynx (13). Only 2 cases have been previously reported in the soft palate (7, 9).

DIAGNOSIS

While the diagnosis of rhabdomyosarcoma will always rest upon microscopic examination, it is believed that the clinical and naked-eye appearances are so characteristic that it should be possible to recognize, or at least suspect, the nature of such tumors grossly. They occur chiefly in childhood or adolescence and at first have the appearance of a simple tumor, producing symptoms by local effects or by causing discharge following ulceration. When first seen they are likely to appear nodular or polypoid, white or flesh color, depending upon the amount of vascularization. While they look soft, they are actually rather firm to the touch. The lobulated processes are often more translucent and tend to be broader at the free than at the attached end, thus presenting a clubbed appearance. The growth may be sessile or may be suspended from the mucosa by a thin pedicle. The polypoid form has long been recognized as characteristic of rhabdomyoma of the vagina and cervix, the so-called sarcoma botryoides.

In the development of metastases, rhabdomyosarcoma differs from other sarcomas in its tendency to dissemination by way of lymphatic pathways. Rhabdomyosarcoma of the palate, for example, may spread to the deep cervical nodes, which may be of rubbery consistency. Central necrosis and degeneration tend to occur in the larger metastatic nodes. Care must be exercised in the microscopic interpretation because of the appearance, which is not unlike that of anaplastic carcinoma. In the later stages, widespread dissemination by the blood stream may occur, but this is usually a terminal event and the lymphatic pathways are usually involved first.

CASE REPORT

A 4-year-old white male was first seen in the office of the referring physician, Manuel M. Monserrate, M.D., on Oct. 21, 1953, following a sudden choking spell the night before. The child was well de-

[1] From The Departments of Radiology and Pathology, Binghamton City Hospital, Binghamton, N. Y. Accepted for publication in July 1954.

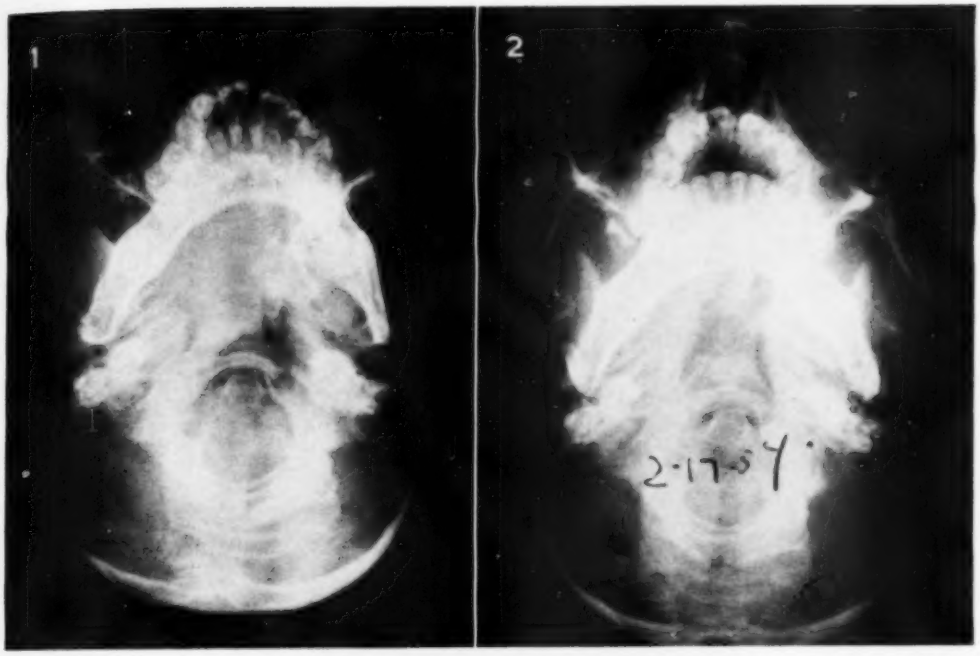

Fig. 1. Basilar view of skull taken on Dec. 28, 1953, showing the soft-tissue mass extending from both sides of the nasopharynx, almost obliterating it.

Fig. 2. Basilar view of skull taken Feb. 17, 1954, following irradiation, showing considerable decrease in the soft-tissue mass in the nasopharynx, particularly on the left. There is still tumor along the right nasopharyngeal wall.

veloped and well nourished but very uncomfortable and restless because of inability to breathe through his nose. Both nasal passages were completely filled with large masses, pearl gray in color, which had the appearance of nasal polyps. The soft palate was considerably elevated and the rounded tip of a reddish mass was seen protruding from behind the uvula. This mass was solid and exhibited no fluctuation. A general anesthetic was given and polyp-like tissues were removed from the nose with nasal snares. Biopsies were taken. The mass in the nasopharynx was then removed with a large adenotome. No significant bleeding was encountered. The total amount of tissue removed was about the size of a small hen's egg. No other significant findings were present at that time. Roentgenograms failed to show any extension into the osseous structures of the skull.

Roentgen therapy was given, with the following factors: 200 kv, 2.0 mm. Cu plus 1.0 mm. Al filtration, skin-target distance 50 cm., h.v.l. 2.3 mm. Cu. Five fields, 4 × 5 cm., were irradiated: two opposing pre-auricular lateral fields, two anteroposterior superior maxillary fields, and a single anteroposterior field directly over the nasal cavity and right paranasal region. Between Dec. 28, 1953, and Feb. 26, 1954, 200 r, measured in air, were given through each of two fields five times weekly, for an estimated mid-nasopharyngeal tumor dose of 6,116 r. A good response to radiation was obtained, as noted by direct observation at the

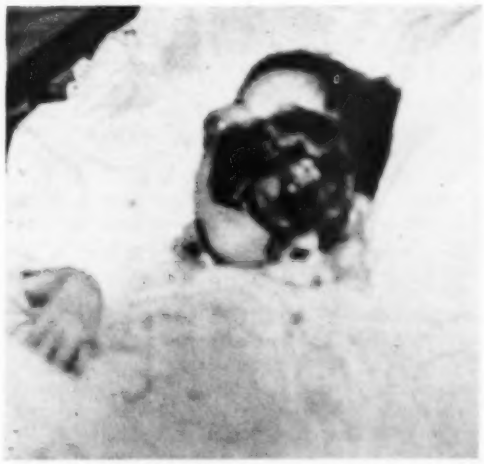

Fig. 3. Photograph taken a week before death. No x-ray therapy had been given since Feb. 26, 1954. The tumor had been partially controlled by irradiation through a right paranasal port. No radiation had been delivered to the region of the left orbit.

nares and indirect observation in the nasopharynx. No erosion through the base of the skull could be detected.

One week following the last x-ray treatment the patient began vomiting and was admitted to the Binghamton City Hospital, where he was placed on intravenous glucose for three days. The vomiting stopped and he was able to eat. He was discharged two days later. At this time the eyes were fixed and the pupils were widely dilated, without response to light. Within two weeks the lesion had invaded the left orbit, from which a mass about the size of an orange protruded, with the eye on top of it. The child was still able to talk and hear but was blind. Death occurred on April 29, 1954. Autopsy was not performed.

Fig. 4. Low-power view of lobulated polypoid tumor with intact pseudostratified columnar epithelium. × *c.* 65.

Specimens of the tumor obtained on two occasions were lobulated, polypoid, firm, flesh-colored, translucent masses. The second specimen was firmer than the first. Histologically, the covering pseudostratified epithelium was intact over the tumor, which was composed of areas with loose textured spindle cells alternating with areas made up of round cells with scanty cytoplasm. Round cells with occasional acidophilic cytoplasm were seen only in sections from the first specimen. More mature forms of rhabdomyoblasts were not found in the sections.

Biopsy specimens were reviewed by several pathologists and were later seen by Dr. Arthur Purdy Stout (15) at the College of Physicians and Surgeons (New York), whom we quote in part:

"This type of growth is, I believe, an embryonal rhabdomyosarcoma. There is some suggestion of this in the first biopsy from the polypoid growth, where among the rounded cells there are some with rather strongly acidophilic cytoplasm. In the recurrence all differentiation seems to have been lost, and the tumor is no longer definitely recognizable as such. I think you can consider this tumor akin to the sarcoma botryoides of the urogenital tract in infants. We have seen it in the orbit, the external auditory canal and middle ear, and the retroperitoneum. In each instance there is a tendency to grow out on a surface, forming polypoid or fungating masses and at the same time to infiltrate deeply. It is the latter feature which kills, as cases with metastases are extremely uncommon. Usually these cases are not controlled by radiotherapy."

DISCUSSION

Rhabdomyosarcoma of the nasopharynx is an extremely rare tumor. Ward and Hendrick (16) do not mention it. Nielsen (10) reported 77 cases of malignant nasopharyngeal tumors observed at the Radium Center in Copenhagen between 1931 and 1941, less than 1 per cent of 10,721 malignant tumors of all sites treated during this time, and among these there was not a single rhabdomyosarcoma. Godtfredsen

(4) found none among 454 cases of malignant nasopharyngeal tumors.

It seems strange, in view of the fact that so large a proportion of the tissue mass of the body consists of muscle, that this tumor is not more common. Ewing (3) states that few regions in the body escape an occasional rhabdomyoma. The largest number originate in the genitourinary tract. Next in order is the neck and adjoining region. The tumor is akin to teratoma, as cartilage, bone, and other tissues may be recognized in microscopic sections. MacCallum (6) believed that these tumors are usually benign at their onset and may become malignant. They probably arise from an early embryonal rudiment which, displaced in the course of development, has grown in an unusual situation.

The relative frequency of rhabdomyosarcomatous tumors in childhood lends support to the theory that many striated muscle tumors may have their genesis in prenatal life. Tumors composed chiefly of muscle fibers may originate in known groups of striated muscles or in remote regions, where they are perhaps embryonal misplants.

Much confusion in the literature exists in the matter of prognosis and radiosensitivity. Jönsson (5) considers rhabdomyosarcoma the most malignant and radioresistant of all the sarcomas of soft parts. Murphy, Dockerty, and Broders (8) pointed out that myoblastomas are in general slowly growing and clinically benign. The case reported here showed considerable radiosensitivity.

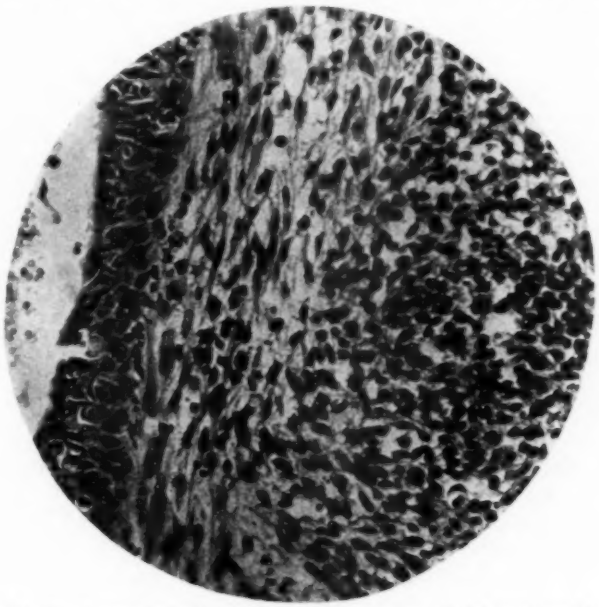

Fig. 5. Loose-textured spindle cells are seen on the left and round cells on the right. × *c.* 475.

SUMMARY

A case of rhabdomyosarcoma of the nasopharynx in a four-year-old white male is presented, which was controlled temporarily by roentgen irradiation. Sensitivity of the tumor was demonstrated by its much more rapid growth through the left orbit, which had received no radiation.

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SUMARIO

Rabdomiosarcoma de la Nasofaringe

Descríbese un caso de rabdomiosarcoma de la nasofaringe que invadía la órbita en un niño de cuatro años.

Existe mucha confusión en cuanto al pronóstico y la radiosensibilidad del rabdomiosarcoma. En el caso actual, se descubrió alguna sensibilidad a la irradiación, no sólo por la respuesta inmediata del tumor en los orificios de la nariz y la nasofaringe, sino también por el desarrollo más rápido a través de la órbita izquierda, que no había recibido irradiación. La muerte sobrevino unos seis meses después de observar al enfermito por primera vez.

Generalized Pulmonary Emphysema as an Isolated Manifestation of Early Cystic Fibrosis of the Pancreas[1]

THEODORE E. KEATS, M.D.

THE PULMONARY manifestations of advanced cystic fibrosis of the pancreas are now generally well recognized. This is not true, however, of the earliest roentgenologic signs, though it is of great importance that these be recognized, so that treatment may be instituted to postpone the later irreversible changes.

Generalized pulmonary emphysema as an isolated manifestation of the earliest phase of pulmonary involvement is frequently seen and, unless one is aware of the existence of this entity, delay in correct diagnosis may result. It is the purpose of the present report to describe this manifestation and to emphasize its importance.

The pathologic changes in the lungs of patients with pancreatic cystic fibrosis are considered to be the result of bronchial obstruction produced by the tenacious secretion which characterizes this disease. Neuhauser (1) has pointed out that the pulmonary changes occur in two stages. First, there are various degrees of bronchial obstruction without infection, which result in obstructive emphysema with poor gaseous exchange. The emphysema is quite irregular and one or more areas of platelike atelectasis or lobar collapse may be seen. In the second stage, infection is superimposed, and there are multiple areas of peribronchial pneumonia. Later, bronchiectasis, atelectasis, and bronchiectatic abscesses supervene.

While it is generally agreed that emphysema and atelectasis are cardinal manifestations of early cystic fibrosis of the pancreas, most reports have been concerned with the irregularity of the emphysema and its association with atelectasis (2–6). However, generalized emphysema alone is not uncommon, and to the uninitiated may present a diagnostic problem if its significance is not understood. This is particularly true since the roentgen picture early in the disease is normal and the emphysema may be overlooked or disregarded if it is not of a marked degree. The later states of atelectasis and infection follow the emphysema in varying periods of time, usually short, but occasionally prolonged.

Roentgenographically, generalized pulmonary emphysema is not always easily recognized in children. This is due, for the most part, to difficulty in obtaining films in the proper phase of respiration. In order to gain a correct impression of the state of aeration of the lungs, it is important to make several exposures in the anteroposterior plane, preferably in inspiration and expiration, and to obtain at least a single lateral projection as well.

In children generalized emphysema may manifest itself by increase in the anteroposterior diameter of the chest, particularly increased width of the retrosternal and retrocardiac spaces, by elevation of the anterior ends of the ribs, flattening of the domes of the diaphragm, increased radiability of the lungs with paucity of parenchymal markings, and diminished size of the cardiac silhouette. Films made in inspiration and expiration may demonstrate poor air exchange, evidenced by limited diaphragmatic and costal excursion.

A statistical analysis of the incidence of generalized pulmonary emphysema in cystic fibrosis of the pancreas was not undertaken. However, of 14 cases of that disease selected at random from the files of the University of California Hospital, 3 showed isolated pulmonary emphysema early in the patient's life, which would indicate the relative frequency of this sign. It is also interesting that in the roentgenograms of 2 of these patients the pulmonary emphysema was not recognized initially.

[1] From the Department of Radiology, University of California School of Medicine, San Francisco, Calif. Accepted for publication in August 1954.

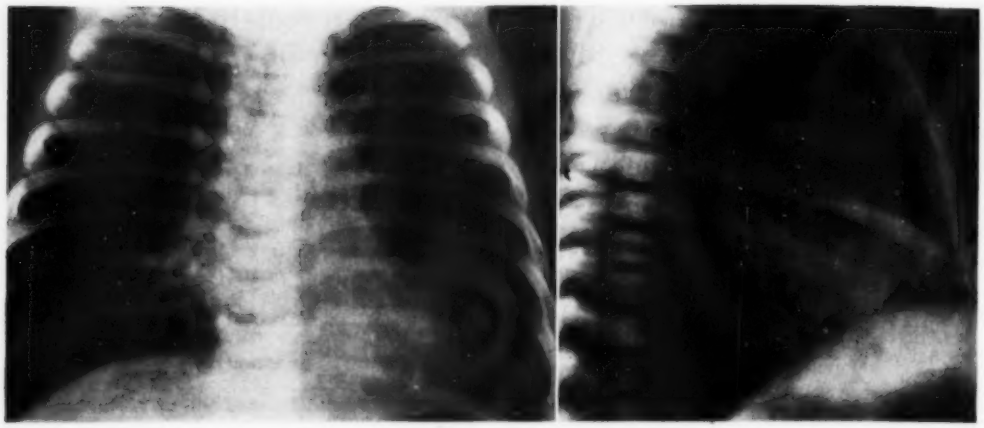

Fig. 1. Case I: Generalized pulmonary emphysema without atelectasis in a two-month-old female with proved fibrocystic disease.

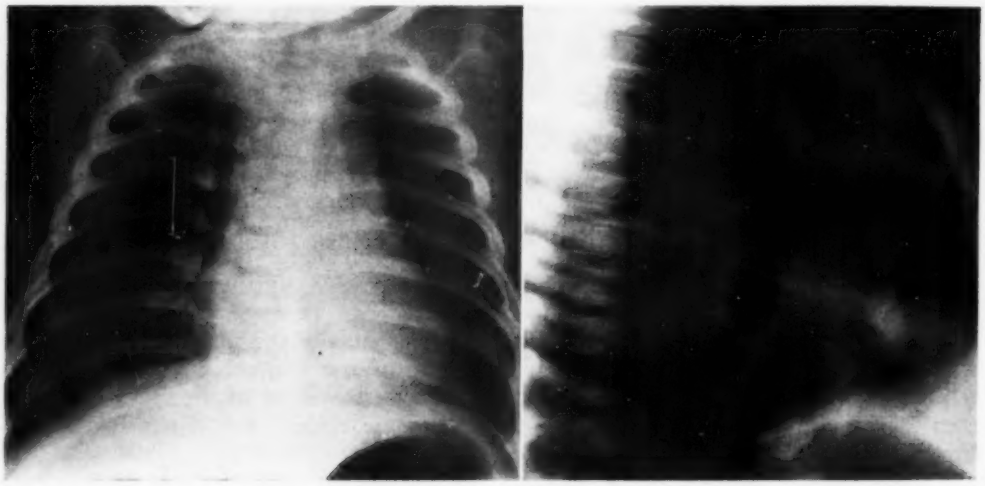

Fig. 2. Case II: Generalized pulmonary emphysema without atelectasis or pneumonitis in a four-month-old boy with proved fibrocystic disease.

The 3 cases are presented to illustrate some of the clinical features in patients whose initial pulmonary roentgen findings are generalized pulmonary emphysema alone.

CASE REPORTS

CASE I: G. S., a two-month-old girl, was admitted with a three-week history of persistent cough that did not respond to antibiotics. There was no history of diarrhea or of abnormal stools. Films of the chest had been made at a community hospital, and the esophagus opacified with iodized oil to rule out a tracheo-esophageal fistula. These studies were reportedly normal. No diagnosis was arrived at, and the child was transferred to the University of California Hospital.

When first seen, the patient was markedly undernourished, with a chronic "deep" cough. The chest was emphysematous in appearance, with a few râles heard in the posterior lung fields. Tracheal or bronchial obstruction was first considered by the clinicians.

Fluoroscopy and films of the chest showed only marked generalized pulmonary emphysema, with little diaphragmatic excursion. No narrowing of the trachea or esophagus was demonstrated (Fig. 1). In spite of the presence of normal stools, the possibility of fibrocystic disease of the pancreas was suggested by the radiologist. This diagnosis was sub-

sequently confirmed by demonstration of the absence of trypsin in the stools.

CASE II: R. W., a two-month-old boy, was admitted with a history of coughing and choking spells since the age of three weeks and of foul stools for two or three days. One sibling had died at the age of two years with fibrocystic disease, and the patient had two cousins, both with fibrocystic disease.

The child appeared chronically ill, with grunting respiration and frequent coughing. The chest was clear on physical examination, and other findings were not remarkable.

Roentgenograms showed generalized pulmonary emphysema without evidence of atelectasis or pneumonia (Fig. 2). The diagnosis of fibrocystic disease was established by demonstration of the absence of trypsin in duodenal aspirations.

CASE III: J. L., a boy of seven and one-half months, was admitted with a history of bulky, foul-smelling stools since birth, and coughing and vomiting since the age of two or three weeks. On physical examination he appeared dehydrated and underweight. Respiration was labored, with intercostal retraction on inspiration. Coarse râles were heard in both lungs.

Roentgenograms taken during this admission showed severe bilateral pulmonary emphysema, more marked on the left, with a suggestion of herniation of the left lung through the anterior mediastinum (Fig. 3). No mediastinal shift with respiration was detected by the fluoroscopist.

Examination of the duodenal secretion revealed no trypsin. Subsequent roentgenograms showed gradual evolution of the typical roentgen changes of established fibrocystic disease of the lungs, with evidence of atelectasis and widespread inflammatory infiltration (Fig. 4).

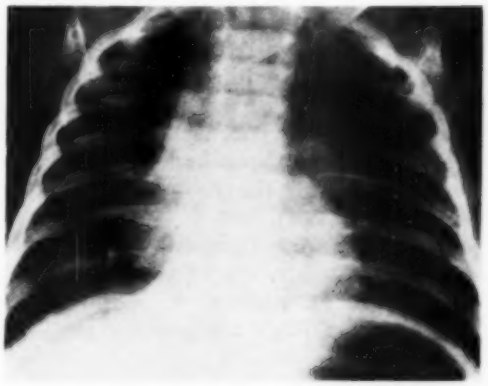

Fig. 3. Case III: Generalized pulmonary emphysema in a boy of four and a half years with proved fibrocystic disease. Slight herniation of the left lung through the anterior mediastinum.

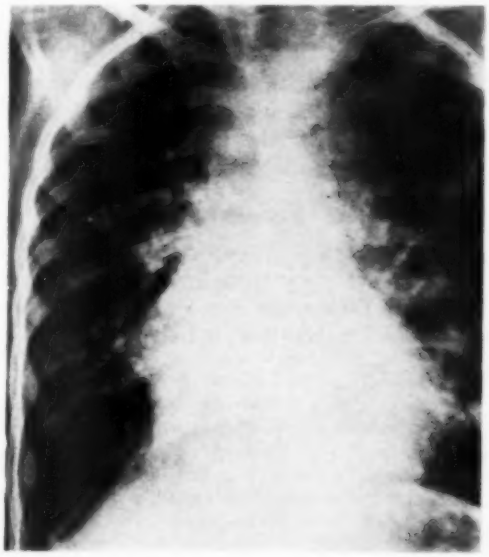

Fig. 4. Case III: Roentgenogram made four years after that in Fig. 3, showing characteristic changes of long-standing fibrocystic disease.

COMMENT

These illustrative cases suggest that generalized pulmonary emphysema may be a transient stage which has its onset in the newborn and soon gives way to the superimposition of atelectasis and infection. In this early stage, while generalized emphysema predominates, the differential diagnosis is not usually a problem if the possibility of cystic fibrosis of the pancreas is kept in mind.

Tracheal or bilateral main stem bronchial obstruction from other causes might cause confusion in some cases. Compression of the trachea by vascular rings or bands can usually be demonstrated by opaque medium in the esophagus. Chondromalacia of the tracheal rings can be excluded by demonstration of the normal caliber of the tracheal lumen. The paradoxic changes of heart size occurring with respiratory movement in tracheal or main stem bronchial obstruction secondary to aspiration are not seen in the emphysema associated with cystic fibrosis of the pancreas.

Ordinarily, congenital pneumatoceles are not sufficiently symmetrical bilaterally to simulate the picture of generalized emphysema. They frequently displace the adjacent pulmonary parenchymal markings as well as the mediastinum, and one can often demonstrate the walls of these cystic structures.

Bronchiolitis usually produces some evidence of inflammation of the pulmonary parenchyma in addition to emphysema. Asthma is not often a diagnostic problem in this age group.

Hyaline disease of the newborn may present a picture of pulmonary emphysema, but the severity of the respiratory difficulty and the lack of improvement of oxygenation with oxygen therapy will help differentiate this condition from pancreatic fibrosis.

Emphysema with or without atelectasis in the newborn should immediately suggest to the radiologist the possibility of cystic fibrosis of the pancreas.

CONCLUSIONS AND SUMMARY

Emphysema is the earliest manifestation of the pulmonary complications of cystic fibrosis of the pancreas. This emphysema, while usually irregular in distribution, may in some patients involve both lungs diffusely to a marked degree and be unassociated with atelectasis or inflammatory disease. The existence of this roentgenologic entity is emphasized and illustrated to facilitate the earliest possible diagnosis of cystic fibrosis of the pancreas.

NOTE: The author wishes to express his appreciation to the Department of Pediatrics of the University of California for the use of the clinical material in this study.

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SUMARIO

Enfisema Pulmonar Generalizado como Manifestación Aislada de Fibrosis Quística Incipiente del Páncreas

El enfisema es la manifestación más temprana de las complicaciones pulmonares de la fibrosis quística del páncreas. Este enfisema, aunque suele ser irregular en su distribución, puede, en algunos enfermos, afectar difusamente ambos pulmones en forma notable, sin acompañarse de atelectasia o enfermedad inflamatoria. Recálcase e ilústrase con grabados la existencia de esta entidad roentgenológica, para facilitar el diagnóstico más temprano posible de la fibrosis quística del páncreas.

Perforation of Necrotizing Primary Retroperitoneal Tumors into the Gastrointestinal Tract[1]

LEO S. FIGIEL, M.D., and STEVEN J. FIGIEL, M.D.

PERFORATION OF a necrotizing primary retroperitoneal neoplasm, resulting in a fistulous communication with the gastrointestinal tract, occurs rarely. To our knowledge, no cases radiographically documented have been described.

In his paper on primary retroperitoneal tumors, Donnelly (2) stated that neoplasms of this group are quite invasive and often become adherent to surrounding vital structures. In view of this circumstance and the great tendency to ischemic necrosis of these tumors, one might expect perforation into surrounding structures to occur more often than is generally recognized. The only direct reference to this complication was found in the Massachusetts General Hospital "Case Records" (1). In this case the diagnosis was established at autopsy. We have recently had the experience of studying two cases in which the diagnosis of excavating retroperitoneal neoplasm with fistulous communication into the gastrointestinal tract was suggested prior to surgery, on the basis of the radiologic examination.

The diagnosis of necrotizing retroperitoneal tumor with perforation into the gastrointestinal tract is possible under the following circumstances:

1. When a scout film of the abdomen demonstrates a soft-tissue mass within which is a pocket of gas. Under such circumstances, one must infer that a portion of the tumor has become necrotic and perforated into the gastrointestinal tract. It may be possible to outline the remaining thickness of the tumor wall in such cases through the presence of contrasting air (see Case I). Demonstration of a thickly marginated wall bordering a gas pocket of variable size should exclude with reasonable certainty such possibilities as a diverticulum or reduplication of the gastrointestinal tract. The rare circumstance of malignant invasion or degeneration in a large duodenal diverticulum might under certain circumstances be difficult of differentiation.

2. When complete gastrointestinal studies demonstrate the presence of a space-occupying intra-abdominal mass which displaces segments of the alimentary tract and a portion of which contains barium and/or gas, indicating the presence of a fistulous communication. The actual site of perforation may be demonstrated in the course of these studies. The approximate size of the tumor is inferred from the amount of displacement of the gastrointestinal segments, as well as from the size of the barium- or gas-containing cavity (see Case II).

CASE I: A 44-year-old white male was admitted to the hospital on July 10, 1952, complaining of weakness, nausea and vomiting, diarrhea with tarry stools, and a 10-pound weight loss in the last six months. His present illness began on July 4, 1952, with sudden onset of chills and fever and an aching sensation in both flanks. He had passed tarry stools intermittently during the last six months and experienced upper abdominal distress following ingestion of certain foods during that period.

The patient appeared chronically ill. A large, firm, tender, non-movable mass was palpable in the upper right abdomen. The hemoglobin was 50 per cent; red cell count 2,700,000; white cell count 15,200, with 78 per cent polymorphonuclear leukocytes, of which 28 per cent were non-filamented. The clinical impression was an ulcerating gastrointestinal lesion, possibly carcinoma, with perforation.

A scout film study of the abdomen on July 10 revealed a smooth, sharply defined soft-tissue mass measuring 12 cm. in diameter in the right upper quadrant, adjacent to L-1–L-4, with a central radiolucent area measuring 6.5 cm. in diameter.

The radiographic impression was a tumor, excavating centrally and probably communicating with the gastrointestinal tract. A localized abscess was excluded on the basis of preservation of soft-

[1] From the Division of Radiology, Grace Hospital, Detroit, Mich. Accepted for publication in August 1954.

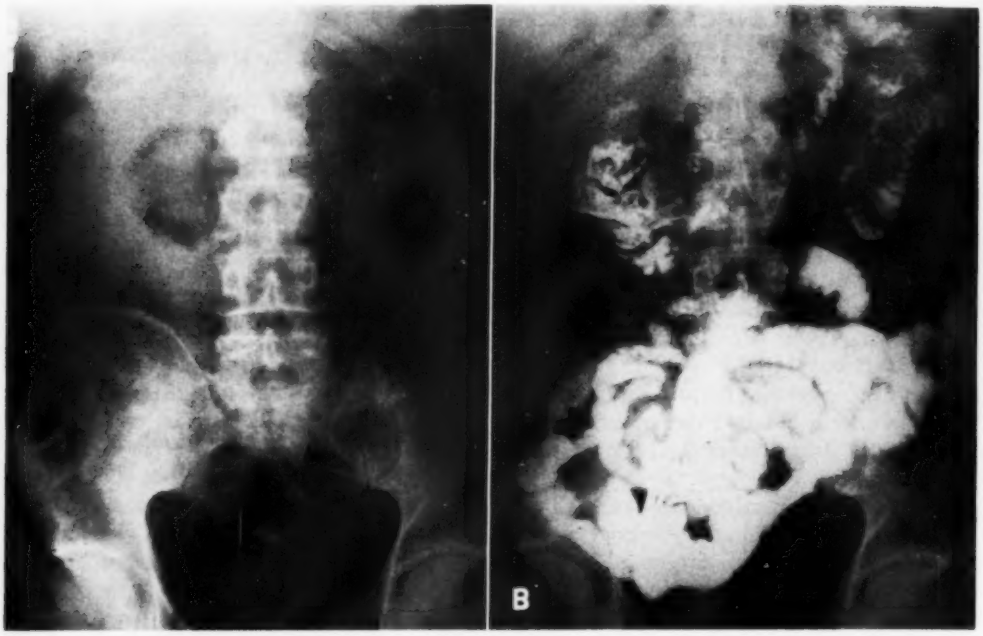

Fig. 1. Case I. A. Roentgenogram showing sharply demarcated soft-tissue mass in right upper and mid abdomen, with central radiolucent area outlining thickness of residual tumor. B. Upper gastrointestinal study demonstrating barium filling the necrotic portion of the tumor. The site of fistulous communication in the second portion of the duodenum is outlined.

tissue detail throughout the abdomen, especially in the area of the mass. A thick margin of soft tissue outlining the periphery of this lesion appeared to exclude a diverticulum or reduplication of the gastrointestinal tract.

Barium study of the upper gastrointestinal tract revealed a fistulous communication between the third portion of the duodenum and the air-filled portion of the mass noted in the scout study. The radiographic impression remained unchanged.

On exploration, July 17, a soft, retroperitoneal tumor was discovered in the upper right abdomen, lying partially behind the duodenum and fixed to the kidney and pancreas. A large amount of old bloody material was aspirated, but the tumor could not be removed.

A biopsy was taken, and pathologic study revealed tumor tissue consisting of parallel streams of elongated spindle-shaped cells with occasional mitotic figures and areas of necrosis. The diagnosis was retroperitoneal degenerating spindle-cell sarcoma.

Postoperatively a fistula developed between the tumor and the skin. The patient died Aug. 7, 1952. Autopsy confirmed the surgical findings as well as the post-surgical complications of intra-abdominal abscess and fistula formation.

CASE II: W. G., a 65-year-old colored male, was admitted to the hospital on Dec. 29, 1952, with a palpable mass in the lower abdomen of three weeks duration.

Three weeks prior to admission the patient had experienced pain in the lower back, radiating to the front of the abdomen. About the same time he noticed a swelling in the abdomen. He also complained of loss of appetite and a weight loss of 15 lb. in the last four weeks. No abnormality of bowel function or in the color of the stools was observed.

The patient appeared well developed, well nourished, and not acutely ill. Palpation revealed a hard, rubbery, fixed mass measuring 4 to 5 inches in diameter, just below the umbilicus in the midline. No movement of the mass on respiration was observed. The clinical impression was retroperitoneal lymphosarcoma.

Retrograde pyelography (Dec. 31, 1952) demonstrated a slight lateral and anterior bowing of the right ureter at the level of L–5, with a faintly outlined soft-tissue mass visible in this area. Barium enema examination (Jan. 2, 1953) showed displacement and compression of the barium-filled terminal ileum, which assumed a curvilinear course, apparently due to displacement by a fixed mass. Upper gastrointestinal and small bowel studies (Jan. 5, 1953) revealed an irregular barium-containing cavity measuring 5 × 12 cm. in its maximum measurements, superimposed upon the right sacroiliac area, with an irregular fistulous tract extending upward

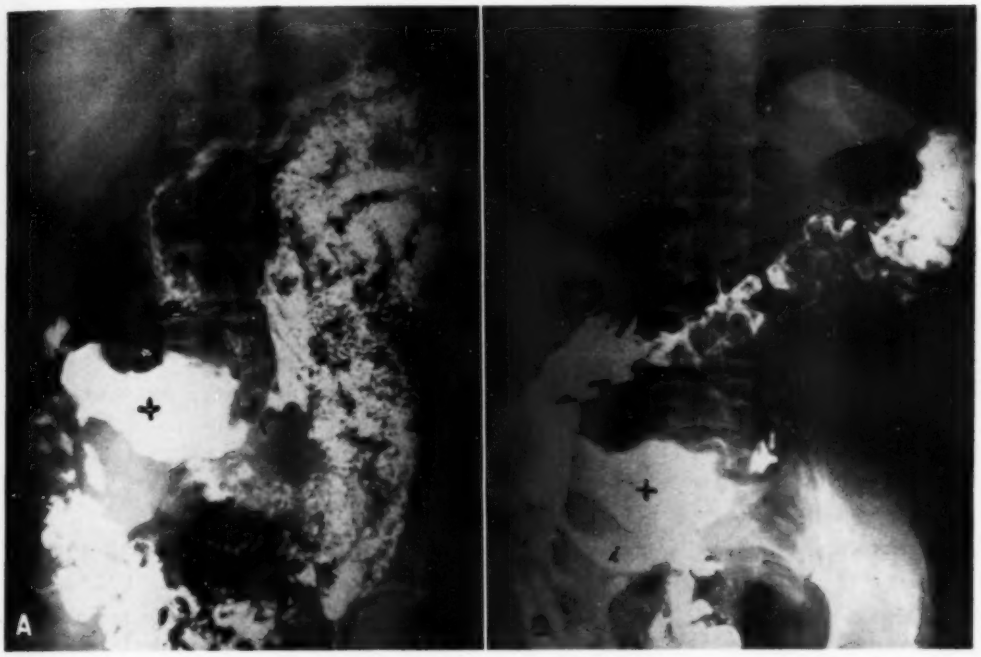

Fig. 2. Case II. A. Roentgenogram showing irregular barium-filled cavity (+) and fistulous communication (arrows) with the jejunum, as well as displacement of barium-filled small bowel loops. B. Four-hour film demonstrating retention of barium in necrotic portion of tumor (+) and compression changes at the terminal ileum (i).

into the left upper quadrant and apparently communicating with the jejunum. There was displacement of barium-filled small bowel loops about the entire circumference of the barium-containing cavity. This combination of radiographic studies suggested an intra-abdominal mass, probably a necrotizing tumor and fistulous communication with the jejunum.

Operation was performed Jan. 10, 1953. A large retroperitoneal tumor extending from the region of the pancreas in the mid-line to the brim of the pelvis was found. The tumor was reddish purple in color and somewhat soft in consistency. Exploration of the small intestine showed apparent communication with the tumor in the region of the ligament of Treitz. A biopsy was taken. No further operative procedure was done.

The pathologic report indicated a tumor of spindle-shaped cells arranged in a haphazard fashion, with a palisading of nuclei in some regions. The tumor tissue appeared moderately vascular. The pathologic impression was a low-grade neurogenic sarcoma.

X-ray therapy was administered postoperatively, and a slight decrease in the size of the tumor was noted on palpation. The course, however, was progressively downhill, with subsequent resumption of tumor growth.

COMMENT

The radiographic studies in these cases demonstrate an unusual complication of retroperitoneal tumor, namely, central necrosis with a fistulous tract communicating with the small bowel. This diagnosis should be considered whenever an intra-abdominal mass containing air or barium is demonstrated, especially if a thick irregular wall lines the air-filled portion of such a mass, as in our first case. In our second case, displacement of gastrointestinal segments was a significant radiologic finding. A tuberculous or fungous abscess, regional ileitis, perforation of a Meckel's diverticulum, or bowel perforation by a foreign body may be difficult to differentiate, but in such cases one would expect a gross alteration of the small bowel pattern rather than a more or less localized mucosal change at the site of perforation. Clinically, a fixed abdominal mass was palpable in both of the cases reported here.

SUMMARY

Two cases of necrotizing, primary retroperitoneal tumors perforating into the gastrointestinal tract are presented.

This diagnosis is suggested radiologically if the following conditions prevail: (1) if a scout film of the abdomen demonstrates a thickly marginated soft-tissue mass containing a central gas pocket of variable size; (2) if complete gastrointestinal studies demonstrate a barium- and/or gas-containing cavity with displacement of intestinal segments indicating the presence of a mass. Clinically the occurrence of a hard, fixed intra-abdominal mass adds support to this diagnosis.

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SUMARIO

Perforación del Tubo Gastrointestinal por Tumores Retroperitoneales Primarios Esfacelantes

Preséntanse 2 casos de tumores retroperitoneales primarios esfacelantes que perforaron el tubo gastrointestinal.

Radiológicamente, queda sugerido este diagnóstico si se cumplen las siguentes condiciones: (1) una radiografía exploradora del abdomen revela una tumefacción de tejido blando y bordes espesos que contiene una bolsa central de gas, de tamaño variable; (2) estudios gastrointestinales completos muestran una cavidad que contiene bario y/o gas, con desplazamiento de segmentos intestinales, indicando la presencia de una tumefacción. Clínicamente, presta apoyo a este diagnóstico la presencia de una tumefacción intraabdominal fija y dura.

The Roentgen Characteristics of Pulmonary Paragonimiasis[1]

MAJOR FRANK L. MILLER, M.C., U.S.A., and CAPT. RHEY WALKER, M.C., U.S.A.

TWO HUNDRED and twenty-seven patients with pulmonary paragonimiasis were studied from a roentgenographic standpoint to ascertain whether or not characteristic patterns exist. The study was prompted by the impression that paragonimiasis did at times produce lesions which were roentgenographically indicative of the disease.

A roentgenographic-pathologic typing of the lesions was made, based on the recognition of the following features and components as seen in all available films in each case: cyst formation, fibrosis, exudation, pleural disease without effusion, a dense or solid appearance, and effusion. The lesions were localized by dividing the lung fields into horizontal thirds, giving the following divisions: right upper, right middle, right lower, left upper, left middle, and left lower. Single and multiple lesion occurrence was recorded.

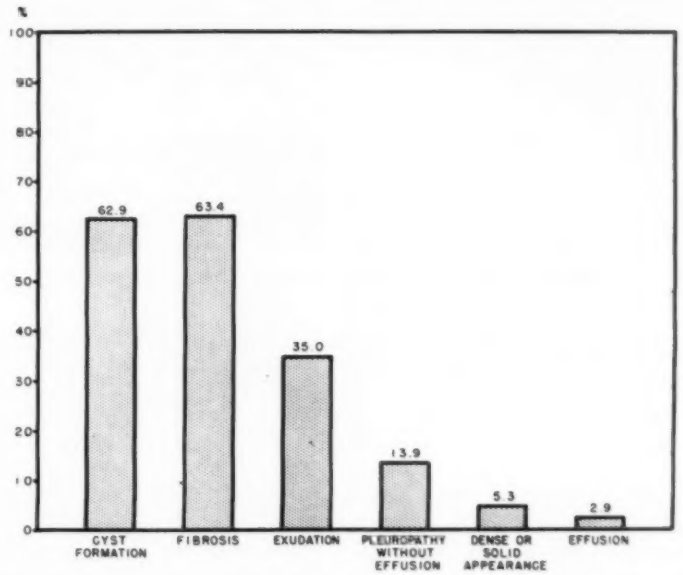


Fig. 1. Roentgen characteristics of 525 lesions found in 194 patients with pulmonary paragonimiasis.

METHOD

Chest roentgenograms were available for study on 227 Korean prisoners of war whose sputum smears were positive for the ova of *Paragonimus westermani* and negative for tubercle bacilli on repeated examinations. No instance of paragonimiasis with known concomitant pulmonary disease was included in this series. The number of films available in individual cases varied from one to eight, the average being 1.9.

Because the initial study of films seemed to indicate the existence of a characteristic lesion in a certain number of cases, its frequency of occurrence was noted.

RESULTS

Of the 227 patients in this series, 33 (14.5 per cent) had normal films. Of the 194 (85.5 per cent) abnormal films, 69 (35.5 per cent) showed single lesions and 125 (64.4

[1] Accepted for publication in July 1954.

per cent) multiple lesions. Of the 525 lesions in the 194 patients, 330 (62.9 per cent) were cystic, 323 (63.4 per cent) were fibrotic, 184 (35.0 per cent) were exudative, 73 (13.9 per cent) showed pleural involvement without effusion, 28 (5.3 per cent) were dense or solid in appearance, and

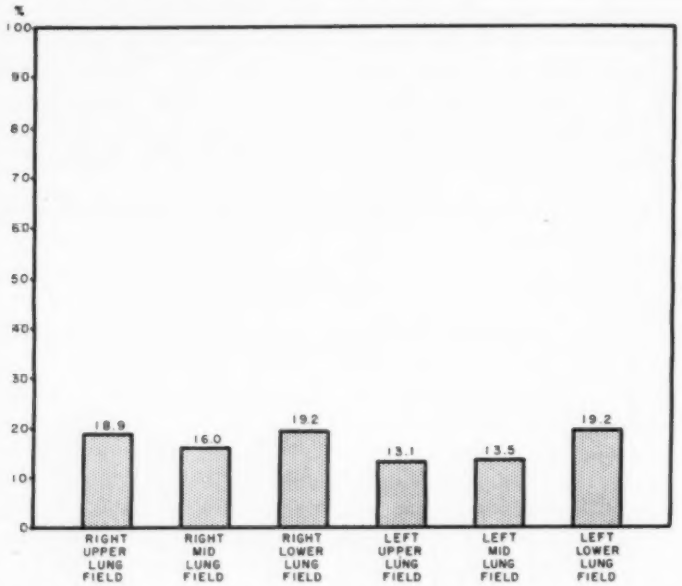


Fig. 2. Location of 525 lesions found in 194 patients with pulmonary paragonimiasis.

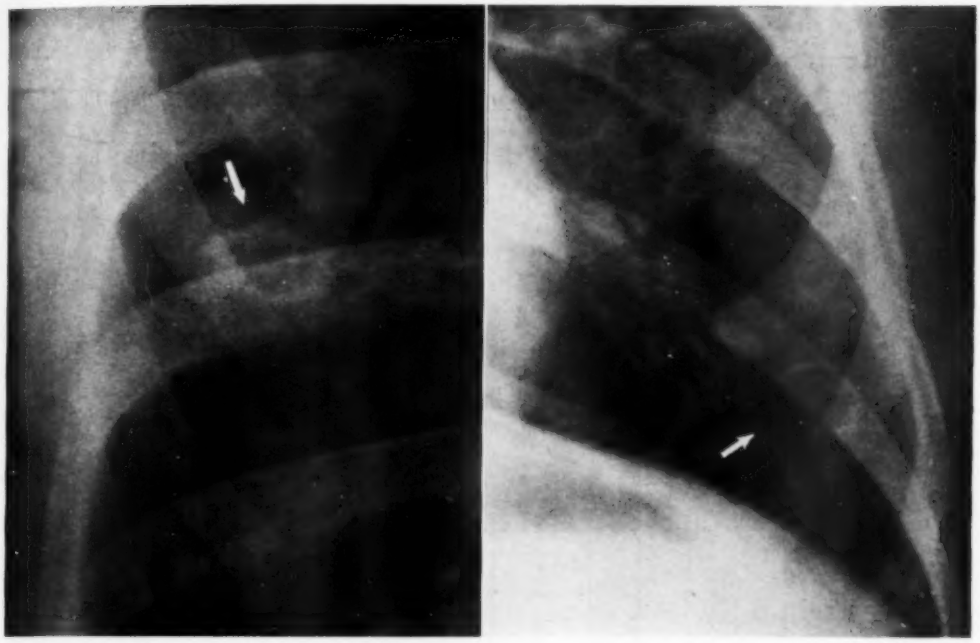
15 (2.9 per cent) had associated effusion (Fig. 1). The upper lung fields were involved in 32.0 per cent of the cases, the mid lung fields in 29.5 per cent, and the lower lung fields in 38.4 per cent (Fig. 2). Pulmonary calcification occurred in 74 cases (38.1 per cent).

Of the 194 patients with abnormal films, 143 had at least one cystic lesion which was thought to be suggestive of pulmonary paragonimiasis. In 51 patients there was no characteristic cystic lesion of this disease.

DISCUSSION

After the films in this series of 227 proved cases of pulmonary paragonimiasis had been reviewed several times and initial tabulations had been made, it was evident that cyst formation occurred with sufficient specificity and frequency to suggest that it was a characteristic roentgenographic finding in the disease. The "typical" cystic lesion of paragonimiasis is 1 to 2 cm. in diameter, ovoid, and surrounded by a narrow ring of fibrous tissue (Figs. 3–5). Probably correlated with the activity of the fluke within a cyst, and the age of the lesion, varying degrees of pericystic inflammatory reaction or exudation are seen. Although exact localization was not possible because lateral films usually were not available, almost all lesions were believed to be peripherally placed. This impression was gained from the fact that the lesions were almost invariably situated in the lateral half of a lung field as seen on the postero-anterior films, and that frequently there was associated pleural disease. No characteristic lesion was seen to involve the apices and none was seen to have a definite fluid level.

While a description of the typical cyst has been given, it should be emphasized that the lesions were by no means uniform in their features. They varied in size, ranging from 0.5 cm. to occasionally as much as 3.0 or 4.0 cm. in diameter, and



Figs. 3 and 4. Characteristic cystic lesions of paragonimiasis seen in a section of a postero-anterior roentgenogram.

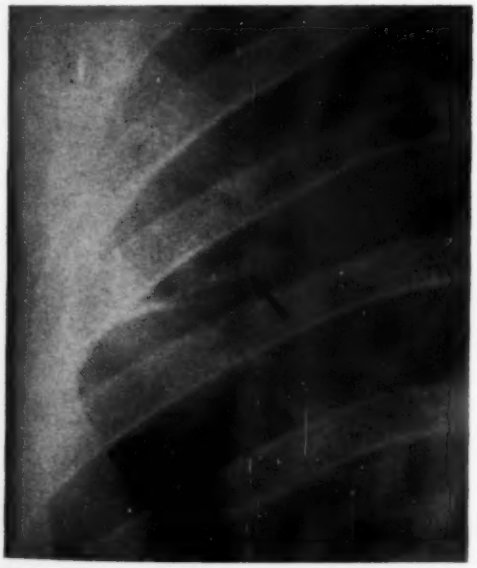


Fig. 5. A characteristic cystic lesion of paragonimiasis as demonstrated in a section of a postero-anterior roentgenogram.

they differed in shape from elliptical to spheroidal, sometimes even appearing angular, suggesting burrowing by the fluke. The older the lesion, the greater the fibrosis; the newer the lesion, the greater the surrounding exudate. These variations occurred not only from one lesion to another but in a single lesion with the passing of time. Cyst formation was occasionally observed radiographically to appear and disappear in a surprisingly short interval. More rapid than the changes in the individual cyst were those seen in the exudative and pleural reactions, thought to be associated with the migration of the fluke through the pleural and pulmonary tissues. It was realized from a study of serial films on single cases that the ability to recognize a cystic lesion frequently depended upon the amount of fibrosis and exudate surrounding the lesion, that is, the surrounding disease usually was considered to favor the recognition of cyst formation. The characteristic cystic lesion occurred in 143 of the 194 patients with abnormal roentgenograms.

It is felt that the cyst formation of paragonimiasis is usually distinguishable radiographically from ulcero-caseous lesions of

tuberculosis by virtue of the fact that there is comparatively little surrounding disease, hilar nodes are not affected, the apices are not involved, the lesions are more peripherally placed, and there is no associated pulmonary calcification. The cysts differ from those of bronchiectasis and from bronchogenic cysts in that the location is more peripheral, fluid levels are not seen, and the surrounding reaction is usually less transient than the pneumonitis occasionally associated with bronchiectasis. The surrounding reaction is greater than with the usual emphysematous bleb. The honeycombed cystic appearance of eosinophilic granuloma of the lung presents a much more angular fibrotic pattern than do the cysts of paragonimiasis. The cavitary lesion of coccidioidomycosis is usually larger, more regular in its outline, and generally has a more narrow surrounding reaction. Usually lung abscesses are larger and the adjacent tissues show more reaction, at least initially.

Calcification was not found to be associated with any suggestive lesion in the study. The calcification that was observed was usually small in amount and presented the appearance and localization of healed primary tuberculosis.

In order to determine the likelihood of a given patient with pulmonary paragonimiasis having certain roentgen characteristics, data were also compiled by cases (Figs. 6 and 7), instead of by total lesions as in Figures 1 and 2. The conclusions of importance that can be drawn from these tabulations are, first, that a case has a 64.3 per cent probability of showing cyst formation (in 3 patients the cyst formation was not considered characteristic), and second, that all portions of the lung in a vertical plane are equally involved.

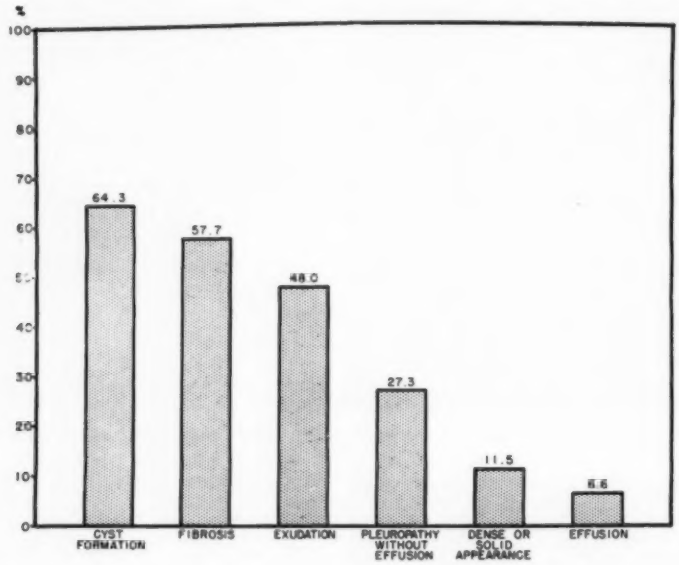


Fig. 6. Roentgen characteristics of 227 patients with pulmonary paragonimiasis, including 33 with normal chest films.

SUMMARY AND CONCLUSIONS

1. Chest roentgenograms of 227 patients with pulmonary paragonimiasis were studied in an attempt to delineate the roentgen features of this disease.

2. The chest roentgenograms of the 227 patients were of normal appearance in 33 (14.5 per cent) and abnormal in 194 (85.5 per cent) cases.

3. A characteristic cystic lesion oc-

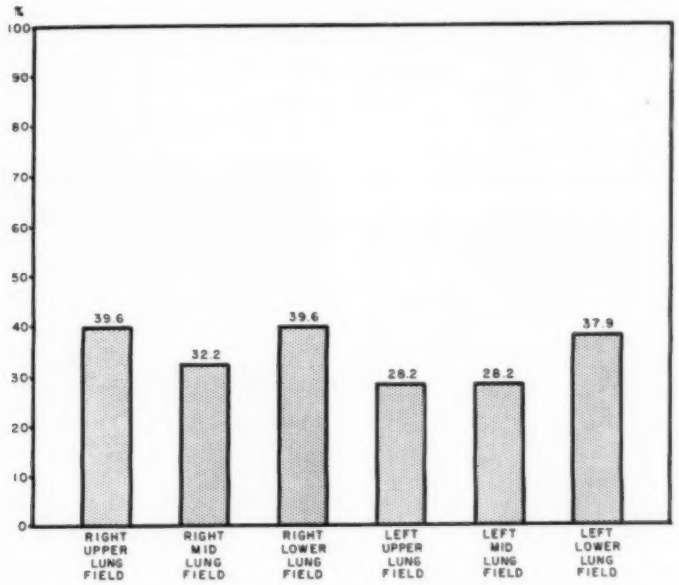


Fig. 7. Lung field involvement in 227 patients with pulmonary paragonimiasis, including 33 with normal chest films.

curred with sufficient frequency (63 per cent) and specificity to indicate that its presence was at least suggestive of pulmonary paragonimiasis.

4. Though subject to considerable chronological variation in size, shape, and component parts, the typical cystic lesion of paragonimiasis, as seen in the chest roentgenogram, is 1 to 2 cm. in diameter, ovoid, and surrounded by a narrow ring of fibrosis, beyond which there usually occurs a pericystic inflammatory reaction.

5. No calcification was seen to occur as a component of a characteristic lesion.

6. Except for rare apical involvement, the lesions were almost invariably peripherally located; no vertical lung field predilection pattern was revealed.

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SUMARIO

Las Características Roentgenológicas de la Paragonimiasis Pulmonar

Las radiografías torácicas de 227 enfermos que tenían paragonimiasis pulmonar fueron estudiadas con mira a delinear las características radiológicas de esta dolencia. Dichas radiografías resultaron normales en 33 (14.5 por ciento) y anormales en 194 (85.5 por ciento) de los casos.

Observóse una típica lesión quística con suficiente frecuencia (63 por ciento) y especificidad para indicar que su presencia era a lo menos sugestiva de paragonimiasis pulmonar.

Aunque susceptible de considerable variación cronológica en cuanto a tamaño, forma y partes componentes, la típica lesión quística de la paragonimiasis, según se observa en la radiografía torácica, mide de 1 a 2 cm. de diámetro, es ovoidea y está circundada por un estrecho anillo de fibrosis, más allá del cual suele haber una reacción inflamatoria periquística.

No se notó calcificación como componente de una lesión típica.

Exceptuada alguna rara invasión del vértice, las lesiones estaban casi siempre localizadas periféricamente, sin revelar patrón de predilección hacia los campos de los vértices pulmonares.

Kaposi's Disease

Report of an Unusual Case[1]

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KAPOSI, IN 1875, first described the disease that bears his name, now more properly known as "idiopathic multiple hemorrhagic sarcoma." About 700 cases have been reported. Kaposi's disease is best known for its cutaneous manifestations, varying from soft vascular to firm pigmented nodules or plaques. These usually occur in the lower extremities; it is generally accepted that they are tumors of low-grade malignancy. Visceral involvement occurs in approximately 10 per cent of the cases, usually late in the course. The gastrointestinal tract is most frequently involved, but lesions have been described in practically every organ of the body. In recent years, Choisser and Ramsey (1), Aegerter and Peale (2), Tedeschi *et al.* (3), Weller (4), Nesbitt *et al.* (5), and others have reported cases in which visceral involvement occurred without evidence of skin lesions. In the case to be presented here, gastric lesions overshadowed the minor skin involvement, which was not even noticed on early examinations.

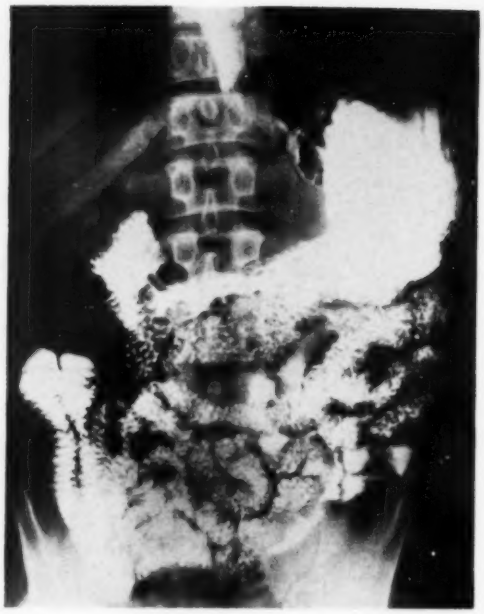

Fig. 1. Multiple intraluminal masses in the gastric antrum.

CASE REPORT

F. S., a 53-year-old Negro male, was admitted in December 1953 with swelling of the legs and thighs of one year duration. He had previously been well. The swelling was first noticed on the right ankle, and later on the right knee. There was no associated dyspnea or orthopnea. About one month prior to admission, the patient had several episodes of either hemoptysis or hematemesis, producing on one occasion a "cupful" of bright red blood. Since then he had experienced marked exertional dyspnea. The edema gradually extended to both thighs. There was no abdominal pain, constipation, change in bowel habit, or loss of weight.

The patient appeared well developed and well nourished, with marked pallor of the mucous membranes, but in no acute distress. The bloodpr essure was 130/70, pulse 120, respirations 20. Positive findings included a firm, fixed, non-tender mass at the angle of the right mandible and bilateral axillary and inguinal lymphadenopathy; the nodes were discrete and non-tender. A Grade II systolic murmur was heard at the base. There was moderate pitting edema of the left leg; the left thigh was swollen, but did not pit. Slight pitting edema of the right leg was present. The liver and spleen were not palpable.

Admission laboratory findings included a marked anemia with a hemoglobin of 5 gm., 17,000,000 red cells, and hematocrit of 20. The non-protein nitrogen was 25 mg. per cent. Urinalysis was negative.

Barium examination of the upper gastrointestinal tract revealed numerous small, smoothly rounded masses from the antrum to the fundus, projecting into the lumen of the stomach, suggesting a diffuse gastric polyposis (Figs. 1 and 2). Peristalsis was normal and the walls of the stomach were pliable.

Several transfusions were given. After these, the platelet count was found to be 30,000. Bleeding and clotting time were normal. Two lymph

[1] From Mt. Sinai Hospital, Cleveland, Ohio. Accepted for publication in August 1954.

node biopsies revealed only chronic lymphadenitis. A few days later, several previously unnoticed small, discrete masses were felt on the lateral aspect of the right thigh. Biopsy of one revealed an 8 × 5-mm. cutaneous nodule, the cut surface of which was dark red and firm. Microscopically this was a Kaposi's tumor (Figs. 3 and 4).

The patient experienced several bouts of massive hematemesis and received sixteen more units of blood. Gastric resection and splenectomy were performed, the latter because of a continued low platelet count. At surgery, the stomach presented numerous small, reddish-brown polypoid masses extending from the pylorus to the cardia; most of them were in the antrum and the body (Fig. 5). A similar lesion was found in the jejunum when anastomosis to the remaining stomach was performed. Histologically these were similar to the skin lesions. The postoperative course was uneventful; there has been no recurrence of bleeding, and the platelet count has returned to normal.

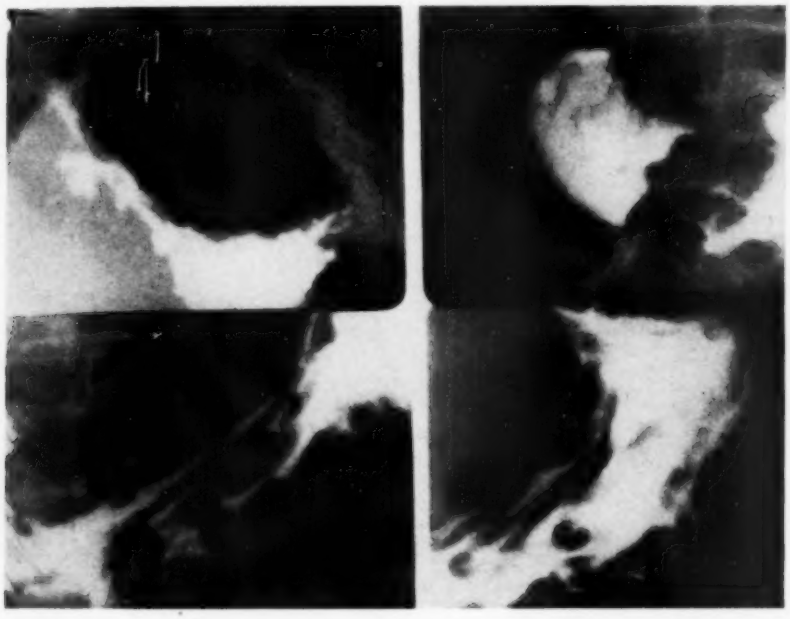

Fig. 2. Compression spot films of stomach better illustrating the smooth, round, well circumscribed masses in the antrum and body.

COMMENTS

This case is of particular interest in that the gastrointestinal lesions of Kaposi's disease overshadowed minor skin involvement. It is further unusual in that the patient was a Negro. Kaposi's disease occurs most frequently in Italians and in Russian or Polish Jews. Only 6 cases in Negroes (2, 6–10) and 1 in a mulatto (11) have been reported in the United States. Kaminer and Murray (12), however, reported 38 cases among the Bantu tribes of South Africa and several cases have been found among other African natives. Kaminer and Murray postulate that this difference in incidence may be due not only to population differences, but to proved hematological and anthropological differences between the Bantu and the West African Negro from whom the American Negro is descended. There is a marked predominance of the condition in males.

Kaposi's disease usually causes death in five to ten years, but numerous cases of survival for twenty-five years and more have been reported. The disease was once considered to be primarily dermatological, with late metastasis to the viscera. However, the occurrence of cases with visceral findings only, as well as those with visceral manifestations occurring prior to the development of skin nodules, suggests a multicentric origin.

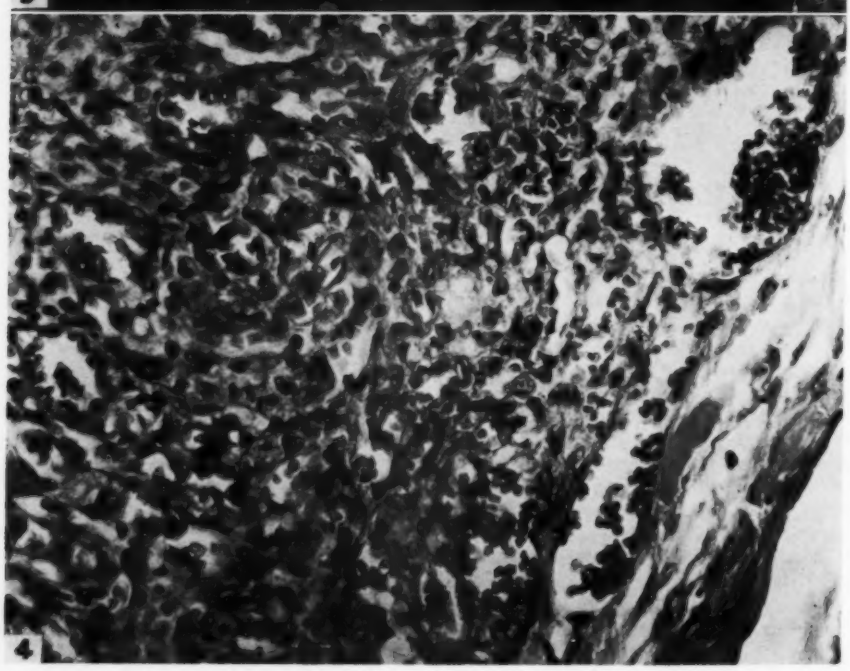

Fig. 3. Low-power view of circumscribed confluent nodular mass in deeper dermis.
Fig. 4. High-power view of nodule, showing closely packed, spindle-shaped cells, numerous capillaries, and focal hemorrhage.

Microscopically, the tumor is characterized by vascular proliferation and by hyperplasia of spindle cells of doubtful origin. Aegerter and Peale suggested that they are transitional cells between fibroblasts and endothelioblasts; Dörffel (13) and others (1) think that they arise from pluripotent cells of the reticuloendothelial system, whereas Symmers (8) believes they originate from primitive fibroblasts. At various stages the tumor may appear to have predominantly inflammatory, granulomatous, or neoplastic characteristics. All three stages may be found simultaneously in one individual. Lymph node enlargement, either regional or general, may accompany the disease but does not necessarily indicate metastasis, since thickening of connective-tissue stroma (14) or hyperplasia of reticulum cells may occur (13). There may be a similar process in the spleen. Extensive edema of the extremities may result from lymphangitic involvement. Although in the case reported here the spleen was not enlarged, there was widening of the marginal zone of some malpighian follicles, and it is postulated that a hypersplenism effect resulted in the lowered platelet count.

SUMMARY

A case of Kaposi's disease (idiopathic hemorrhagic multiple sarcoma) is described, believed to be the seventh to be reported in an American Negro. The case is unusual, also, because of the predominance of gastrointestinal lesions, which may have preceded the development of the cutaneous nodules.

The gastric lesions consisted of multiple small Kaposi's tumors in the mucosa and submucosa, some of which were superficially ulcerated and produced massive bleeding.

Mt. Sinai Hospital,
Cleveland, Ohio

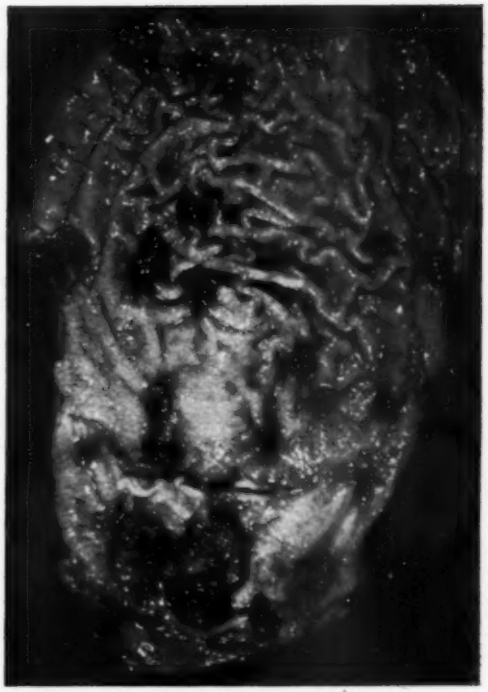

Fig. 5. Resected portion of stomach showing multiple mucosal and submucosal tumors. Some of these are discolored by hemorrhage. Superficial ulceration was present in several of these lesions.

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SUMARIO

Enfermedad de Kaposi. Presentación de un Gaso Extraño

Descríbese un caso de enfermedad de Kaposi (sarcoma múltiple hemorrágico idiopático), el séptimo comunicado en un sujeto de raza negra de los Estados Unidos. El caso es además extraño, debido al predominio de lesiones gastrointestinales, que tal vez precedieran la aparición de los nódulos cutáneos.

Las lesiones gástricas consistían en pequeños tumores múltiples de Kaposi en la mucosa y la submucosa, algunos de los cuales estaban ulcerados en la superficie y producían hemorragia masiva. Se descubrió una lesión semejante en el yeyuno, en el sitio de la anastomosis al estómago, consecutiva a una gastrectomía parcial.

Treatment of Multiple Myeloma with Radioactive Iodine and Radioactive Iodinated Serum Albumin[1]

JOSEPH P. KRISS, M.D., HOWARD R. BIERMAN, M.D., SYDNEY F. THOMAS, M.D., and ROBERT R. NEWELL, M.D.

SINCE THE LESIONS of multiple myeloma are widespread, satisfactory control of the disease process would appear possible only with an effective systemic therapeutic agent. Unfortunately, the results of treatment by chemotherapeutic agents such as urethane, steroid hormones, and diamidines remain, by and large, unsatisfactory (1–4). External irradiation has been successful in relieving isolated painful areas, or lesions of unusual size or destructiveness. Radioactive isotopes given internally can irradiate all the lesions but are limited by the tolerable total-body dose. Radioactive phosphorus (P^{32}) has received a trial (5–7) because, in general, leukemic and neoplastic tissues concentrate this isotope preferentially. Radiophosphorus collects preferentially also in the bone marrow, and the dose must be held below that which will produce a severe reduction in granulocytes, platelets, and red blood cells. It seemed logical to try radioactive iodine (I^{131}), which would be evenly distributed in vascularized tissues without selectively concentrating in the blood formers. It is the purpose of this paper to report experience with two forms of I^{131} therapy: (*a*) massive doses of the isotope in patients pretreated with stable iodide, and (*b*) radioactive iodinated serum albumin (RISA).[2] The diagnosis of multiple myeloma in all cases was established by examinations of urine, peripheral blood and bone marrow, roentgenograms of the bones, and electrophoretic study of the plasma proteins.

SERIES I: TREATMENT WITH I^{131}

Series I comprises 24 treatments given to 7 men and 2 women, ranging in age from forty to seventy years. Pertinent clinical and laboratory data on these cases are summarized in Table I. All patients were hospitalized for the isotope therapy. Loss of circulating I^{131} to the thyroid gland was prevented by giving stable potassium iodide, 15 drops daily, for five days before and seven days after the isotope treatment. This, however, does not prevent rapid loss of I^{131} through the urine. For this reason, large doses are required to achieve suitable radiation to the blood. Doses of 100 to 200 mc of I^{131} are widely reported in the treatment of thyroid carcinoma (8, 9) and are known to be well borne.

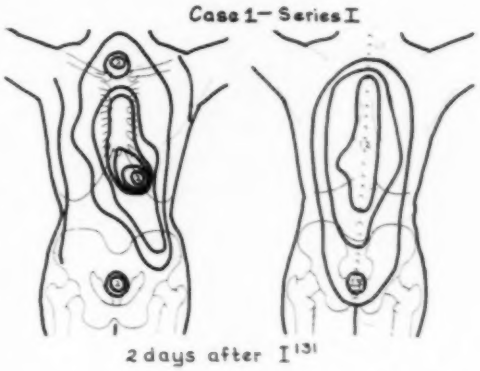

Fig. 1. Scanned contours of equal activity forty-eight hours after a 150-mc dose of I^{131} in Case 1, Series I. Numbers on body charts indicate relative activity of area compared to that of pectoral region. Active areas corresponding to thyroid uptake and gastric and urinary excretion are seen.

After preliminary stable iodide treatment, each patient drank about 150 mc of I^{131}. All urine was collected in waxed cartons for several days. Venous blood samples were obtained about two hours after treatment and daily thereafter for a number of days. The urine and 1-c.c.

[1] From the Department of Medicine, Stanford University School of Medicine, San Francisco; the City of Hope Medical Center, Duarte; the Palo Alto Clinic, Palo Alto, Calif. Supported in part by an institutional grant to Stanford University School of Medicine by the American Cancer Society, 1954.
Presented in part at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles Calif., Dec. 5–10, 1954.
[2] RISA was obtained from Abbott Laboratories, North Chicago, Ill.

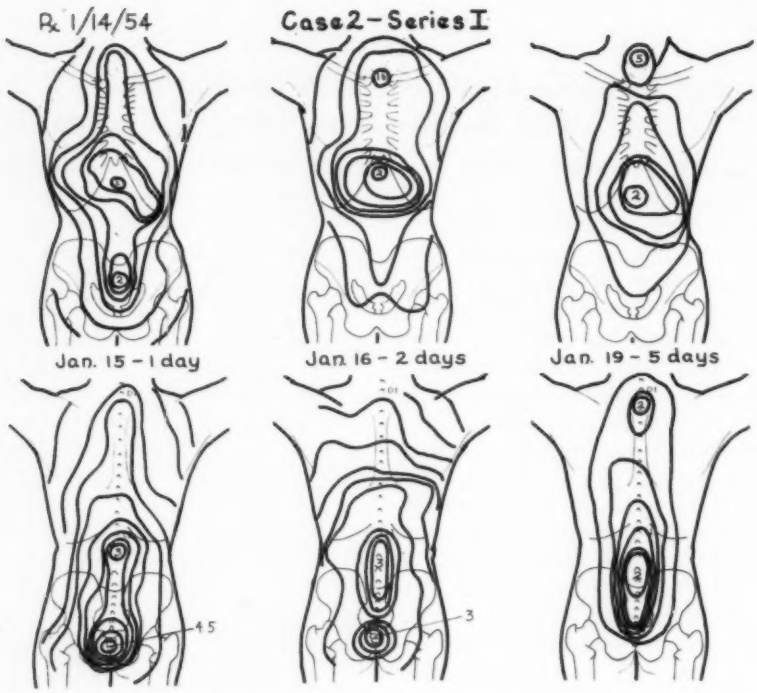

Fig. 2. Scanned contours of equal activity, front and back, at one, two, and five days after I^{131} in Case 2, Series I. Marked concentration of I^{131} in the lumbosacral region is observed at each measurement, even when the bladder is empty.

TABLE I: CLINICAL DATA PERTAINING TO SERIES I: TREATMENT WITH I^{131}

Case	Age, sex	Duration disease prior to I^{131} (months)	Previous therapy	No. I^{131} doses	Total dose I^{131} (mc)	Follow-up since start of I^{131} (months)	Side-effects	Pain relief	Comment
1	57 M	7	None	3	497	21	None	Marked	Subsequently treated with RISA (Case 1, Series II).
2	63 M	19	Urethane; x-ray	5	510	15	Stomatitis, nausea, anorexia	Marked	Thyroid gland ablated with I^{132}. No new bone lesions in 15 months.
3	51 M	3	X-ray	1	143	2	None	None	Died. No autopsy.
4	60 F	1	None	1	180	1/2	None	...	Comatose when treated. Died in renal failure. Palpable skull tumor regressed.
5	62 M	4	Urethane	2	252	6	None	Very slight	Lost to follow-up.
6	57 M	2	X-ray	2	90	4	None	Marked	Relapse 2 months after second treatment; died.
7	40 F	12	X-ray	2	264	10	Anorexia	None	Subsequently treated with RISA (Case 2, Series II).
8	59 M	7	X-ray; transfusions	1	150	2	Anorexia, nausea	...	No pain before treatment nor after. Death by suicide.
9	70 M	1	None	7	288	10	Perforation of gastric ulcer	Marked	Bony lesions progressed. Subsequently treated with RISA (Case 3, Series II).

samples of blood were measured with a scintillation counter. Unless the patient was too ill, the body was scanned daily with a collimated counter until the pattern of isotope distribution appeared established and most of the I^{131} had been recovered in the urine.

the lumbosacral region. On the second day, the bladder hot spot was eliminated by voiding, but localization to the back persisted. Considerable activity remained even after five days. This patient, a sixty-three-year-old man, had lost several inches because of repeated compression

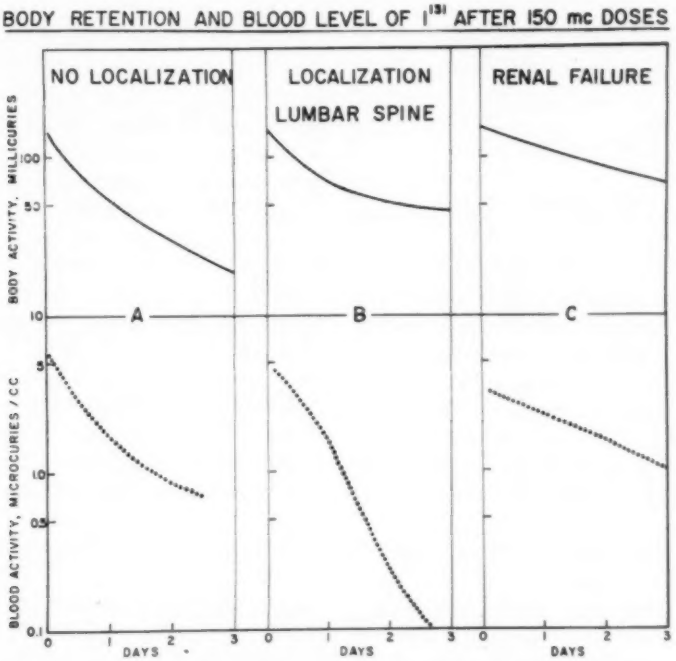

Fig. 3. Course of body retention and blood level of I^{131} after 150-mc doses, Series I. A. Case 1, showing roughly parallel declines in blood and body activity. B. Case 2, showing body retention despite rapidly falling blood level. C. Case 8, showing body and blood activities both remaining high, due to renal failure.

In 6 cases the distribution was much alike. Case 1 (Fig. 1) is typical. The chart shows contours of equal activity forty-eight hours after treatment. The numbers within the more active areas indicate the ratio of activity there compared to that of the pectoral region. Thyroid uptake is slight. Active areas corresponding to gastric and urinary excretion of I^{131} are seen. No concentration in the bones is evident.

Case 2 (Fig. 2) showed a surprisingly different distribution of I^{131}. At one day, the usual "hot spots" were present over the stomach and bladder, but posteriorly there was a three- to fivefold concentration in fractures of the lumbar spine, and he had been given all the roentgen irradiation that his skin would bear. This degree of I^{131} localization is unique in our experience, but Cases 6 and 9 showed similar though less marked localization over the sites of pathological fractures of the spine.

Total-body irradiation dose rate depends on the amount of isotope retained in the body. This is calculated by subtracting the cumulative urinary excretion from the amount administered. Figure 3 shows the course of body retention and blood levels of I^{131} in three types of cases. In Case 1 (Fig. 3A), the results were typical

TABLE II: SUMMARY OF EFFECTS OBSERVED IN SERIES I: TREATMENT WITH I^{131}

Total cases	9
Subjective effects	
Moderate or severe pain prior to I^{131} therapy	7
Moderate to complete pain relief	4
Improved strength	4
Relapse in 3 to 4 months	4
Objective effects	
Regression of palpable tumors	2
Improvement in serum protein pattern (temporary)	1
Improvement of thrombopenia (temporary)	1
Improvement of anemia	0
Arrest of progression of disease, 15 months	1
Dead	4
Side-effects	
Radiation sickness	3
Perforation gastric ulcer	1
Anemia	1
Stomatitis	1
Hypothyroidism (one by design)	2
Follow-up in surviving cases	13–21 months

of 4 of the 9 cases. After an intake of 150 mc, the amount remaining in the body fell rapidly as the iodide was excreted in the urine; by the third day only about one-tenth of the dose remained. It will be noted that within a few hours of treatment, a blood level of about 6 μc/c.c. was reached and that the fall in blood activity, as expected, was roughly parallel to the curve of body retention.

In marked contrast to this is Case 2 (Fig. 3B), with localization of I^{131} to the lumbar spine (Fig. 2). The body retention was much greater, so that one-third of the dose still remained at three days, although the radioactivity left the blood even more rapidly than in the first case.

In patients with renal insufficiency, body retention and blood level both remain high. This series included 2 such cases, 4 and 8. Figure 3C charts the data from the latter. Such patients can be seriously overdosed if given 150 or 200 mc, which experience has shown to be quite tolerable for patients with normal renal function.

Table II summarizes the subjective and objective results as well as the toxic side-effects of treatment in Series I. Of 7 patients who were weak and suffering moderate to severe pain, 4 became stronger and more comfortable, usually after two to three weeks. All relapsed within four months, but retreatment was usually effective. One of this number has died. Of those whom treatment did not help, all 3 are dead, 1 by suicide and 1 probably of cardiac disease. The third was critically ill and comatose prior to treatment. In none was death attributed to isotope therapy. Postmortem examination in Cases 4 and 8 confirmed the diagnosis of multiple myeloma.

It is apparent that objective evidence of improvement is meager and temporary (Table II). Case 2 may be an exception. Prior to treatment with I^{131}, serial roentgenograms had shown progressive involvement and collapse of some dorsal and lumbar vertebrae despite intensive roentgen therapy. After two courses of I^{131}, it was decided to ablate the thyroid with I^{131} and maintain the patient on thyroid therapy, so that if additional I^{131} were required, this could be given without pretreatment with stable iodide; isotope dilution would thus be avoided. This was done and subsequent to thyroid ablation, 2 additional treatments with I^{131} were given. Serial roentgenograms of the bones have shown no new lesions in fifteen months.

The treatment is not without side-effects. Mild radiation sickness, consisting of anorexia, nausea, and occasional vomiting, occurred in 3 patients within the first two weeks after treatment, lasting about a week. More recently these symptoms have been well controlled by Thorazine, 25 mg. orally three times a day. In Case 2 there had been a tendency toward glossitis before treatment; this was aggravated and accompanied by a transient stomatitis probably caused by the I^{131} present in the excreted saliva. In Case 9 a gastric ulcer, not known to have existed, perforated forty-eight hours after treatment. Exacerbation of an existing, hypochromic anemia occurred in Case 9. Hypothyroidism was induced intentionally in Case 2; in Case 7 it occurred after two treatments with I^{131} and two treatments with RISA (*vide infra*), despite thyroid blockade with stable iodide.

SERIES II: TREATMENT WITH RADIOACTIVE IODINATED SERUM ALBUMIN (RISA)

With the exception of the 3 cases in

TABLE III: CLINICAL DATA PERTAINING TO SERIES II: TREATMENT WITH RADIOACTIVE IODINATED SERUM ALBUMIN (RISA)

Case	Age, sex	Duration disease prior to I^{131} (months)	Previous therapy	No. RISA doses	Total dose RISA (mc)	Follow-up since start of RISA (months)	Side-effects	Pain relief	Comment
1	57 M	18	I^{131} (Case 1, Series I); x-ray	2	38	7	None	None	Subsequently re-treated with I^{131}, with marked pain relief.
2	40 F	18	I^{131} (Case 7, Series I); x-ray	4	42	9	Nausea, anorexia, hiccups	Marked	Improved strength; weight gain; no new bone lesions in 9 months.
3	70 M	7	I^{131} (Case 9, Series I); transfusions; urethane	1	15	3	None	Marked	Improved strength and exercise tolerance.
4	62 F	12	Thyroidectomy; parathyroidectomy; urethane; x-ray	2	31	6	Nausea, anorexia, severe	Marked	Relapse 3 months after first dose, with progression of bone lesions.
5	62 M	40	X-ray	1	18	5	None	...	No pain. Died with severe anemia which antedated RISA.
6	46 F	36	Transfusions; cobalt	1	17	6	None	...	No pain. Severe anemia, not affected by RISA.
7	69 M	10	Transfusions; iron; vitamin B_{12}	1	14	3	None	...	No pain. Severe anemia, not relieved by RISA. Transient rise in platelet count.

which radioactive iodine localized to the spine, it seemed likely that any therapeutic effect observed was due to the whole-body irradiation delivered *via* the circulation and interstitial fluids. It occurred to us that similar whole-body irradiation could be achieved with radioactive iodinated serum albumin (RISA), which offered advantages of very low urinary excretion and consequent longer retention in the blood. Hence, a lower dose would be required to achieve the desired radiation effect. Lack of diffusion into extravascular tissue spaces and into tumor cells might, of course, prove to be a disadvantage.

RISA must be given by vein to avoid digestion. Three men and 4 women have received a total of 12 doses of RISA. Three of them had been treated previously with ordinary I^{131}. Table III lists the pertinent clinical data on these patients. Two were hospitalized during treatment. Two patients (Cases 2 and 4) were bedridden; the others were ambulatory throughout the period of observation. Three patients (Cases 5, 6, and 7) were free of pain but were doing poorly and suffering the effects of intractable anemia. The dose was 10 to 20 mc (0.2–0.3 mc/kg. body weight), or about one-tenth the dose of ordinary I^{131} (*vide supra*).

Samples of venous blood were obtained from the opposite arm ten minutes after treatment, after a few hours, then daily for a week, and weekly thereafter for about a month. Saturated potassium iodide solution, 5 drops daily, was administered after treatment and continued for three weeks in order to protect the thyroid from the I^{131} which is slowly released from the albumin.

Figure 4 shows the course of plasma activity of I^{131} after administration of RISA to the 7 patients. Initial blood levels

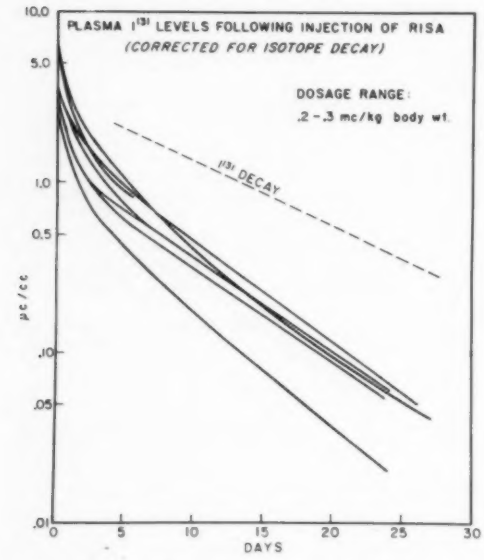

Fig. 4. Course of plasma activity in all 7 patients given radioactive iodinated serum albumin (RISA) intravenously.

ranged from 3 to 7 μc/c.c. In all cases the activity fell rapidly to about 1 or 2 μc/c.c. by the end of the second day, and slowly thereafter. Plasma radioactivity was readily measurable for a month. Urinary excretion of I^{131} was less than 5 per cent per day in each of 3 cases measured. From the residual body burden, day to day, we estimate an average total body dose of 60 rads. From the diminishing blood levels, we estimate the dose in larger blood vessels as amounting to some 200 rads. A very bloody tumor tissue might approach this latter value. In fact, in Cases 5 and 6, marrow obtained by needle three days after treatment with RISA proved to have activities identical with that of peripheral blood.

The results of RISA therapy are summarized in Table III. It is noteworthy that relief of pain was achieved in 3 of 4 cases, but that no improvement occurred in 3 patients with severe anemia and no pain. Radiation sickness, similar to that observed in Series I, occurred in 2 of the 7 patients. In Case 4 the symptoms were marked and lasted about three weeks despite Thorazine therapy. In subsequent treatments in this case, these symptoms were avoided by the administration of smaller doses of RISA (5 mc) at monthly intervals. In Case 2 the response to treatment was surprisingly good. Prior to treatment with RISA, this thirty-year-old woman, had received two treatments with I^{131}, but she was still bedridden with pain, and skeletal lesions were developing rapidly. The first treatment with RISA was followed by marked pain relief and some weight gain; since then she has received 3 additional treatments without waiting for relapse to occur. Her weight has gone from 87 to 109 pounds, and serial roentgenograms have shown no new lesions in nine months. Although on close inspection of the roentgenograms, the structure of some of the bones seems improved, marked re-calcification of diseased areas has not occurred.

DISCUSSION

Any consideration of the effects of radioactive iodine in multiple myeloma must include at least two factors: (1) whole-body irradiation and, more particularly, irradiation of the blood and bone marrow by the circulating isotope; (2) local internal irradiation as a result of selective localization of I^{131}. The first of these was anticipated, and, indeed, was the consideration which prompted the study. Comparison might be drawn between such therapy and whole-body external irradiation.

Several workers have calculated the internal irradiation. On the basis of Seidlin's (9) figures, 150 mc of I^{131} give a generalized body dose of 45 rep, and a blood dose of 84 rep. The uncertainty or the variation from patient to patient is probably above 50 per cent. One could expect the dose in the marrow to be similar to the blood dose. In one of our patients however, in whom I^{131} localized in myelomatous areas (Case 9, Series I), the aspirated marrow showed seven times the activity of the blood. The explanation of this localization (*e.g.*, in Case 2, Series I) is baffling. In the first place, the dilution of I^{131} by administration of large amounts

of stable iodide would seem to preclude the possibility that the isotope could concentrate in any tissue showing avidity for iodine. Any apparent concentration would presumably reflect the increased vascularity of the diseased area. That such is not the case is proved by the fact that (1) blood concentration was falling rapidly at a time when localization was occurring, (2) activity remained in the spine long after it had been essentially cleared from the blood, and (3) a subsequent test with RISA (where the I^{131} is not free to diffuse from the plasma) showed that the radioactivity after RISA was very definitely reduced over the very areas which had shown such high activity after I^{131}. This indicated that the lesions were not particularly vascular, a concept more in keeping with the histological appearance of myelomatous infiltration or replacement of marrow. It would appear that either the intact myeloma cell in this case had some use for iodide in its metabolic processes, or else that the iodide had a selective affinity for the intracellular myeloma protein. We would have liked to do excisional biopsies after I^{131} and after RISA to confirm the uptake and to make radioautographs, but the patient would not permit it.

In Case 2, we blocked the thyroid with stable iodide for only the first two doses of I^{131}. The third dose, therefore, ablated the patient's thyroid, and the fourth and fifth doses were diluted only with the patient's natural small store of iodine, and without competition from the thyroid gland. We then observed skeletal retention of a degree as great as at the first two treatments, but achieved with about half the dose. The amount of radiation delivered to the bone marrow in Case 2 is extremely difficult to estimate, because we do not know the concentration of I^{131} within the spine, or the biological half-life of the isotope. Assuming that the retained 50 mc were distributed in a mass of 250 gm. of lumbosacral bone, an initial concentration of 200 μc/gm. would be achieved. This might give a local irradiation comparable to that accomplished in irradiation of the hyperplastic thyroid gland with I^{131}, *i.e.*, 8,000 to 16,000 rep.

With RISA therapy, the problem of radiation dosage is less complex. No localizations of isotope have occurred, and no discrepancies between peripheral blood and marrow blood radioactivity have been noted. With a dose of 0.2 to 0.3 mc/kg. body weight, irradiation to the blood and marrow has been estimated at about 200 rads. Thus, about 15 mc of RISA achieves approximately the same blood and marrow irradiation as 300 to 400 mc I^{131}, and a body irradiation comparable to that resulting from about 200 mc I^{131}. The ease of handling, decreased radiation exposure to personnel, elimination of urine collections, and ambulatory management of cases are all obvious advantages of using RISA. It is advisable to try I^{131} first, and look for localization in the lesions, for if this occurs with I^{131}, RISA would not be preferred. One patient (Case 1, Series II) failed to reach satisfactory levels of radiation despite very large doses of RISA; his calculated plasma volume was in excess of 12 liters. In none of the other cases was a high plasma volume observed.

A word of caution is in order regarding the evaluation of any therapeutic measure in multiple myeloma. It is well known that the disease is extremely variable in its manifestations and its course. Although the trend is, overall, downhill, long quiescent periods may occur without progression of lesions (10). It becomes difficult, therefore, to distinguish a true therapeutic effect from a spontaneous remission. In any given case, it may be impossible to settle this question with certainty. Only if a series of cases respond similarly can one be more positive. Until such time as more objective evidence of improvement is obtained, it is prudent to regard the beneficial effects of I^{131} as palliative only. Since relapses have occurred regularly three to four months after treatments, we are currently adopting a policy of repeating the doses every two or three months without waiting for a relapse.

The hematological effects of the I^{131}

in our cases were negligible. Leukopenia has not developed in any patient. Red cells and hemoglobin were diminished in only 1 case (Case 9), in which we attribute it to perforation of a peptic ulcer. In 2 cases (Case 2, Series I; Case 7, Series II) with thrombocytopenia (40,000 per cu. mm.) transient increases in platelet count (*circa* 150,000 per cu. mm.) developed a few days after treatment. All patients continued to show evidence of myeloma on repeated marrow aspirations after treatment, although the percentage of myeloma cells varied with the particular specimen examined.

Our experience lets us draw no conclusions as to whether I^{131} is better than P^{32} or urethane or other chemotherapeutic agents in multiple myeloma. Many an individual case of striking improvement is reported for one and another therapy. We think it warranted to continue to try I^{131} and hope to collect enough cases to give a quantitative idea of what may be expected from it.

SUMMARY AND CONCLUSIONS

1. Systemic treatment of multiple myeloma has been carried out with radioactive iodine and radioactive iodinated serum albumin (RISA). Of 9 patients given I^{131}, 4 gained strength and were relieved of pain. This happened in 3 of the 7 given RISA.

2. Relapse in three to four months is the rule. If relapse occurs, re-treatment is usually effective. Management of a given case, therefore, usually consists of a series of treatments. In 2 patients, rapidly progressing disease has been apparently arrested for fifteen months with I^{131} and nine months with RISA, respectively.

3. Anemia was not improved, there were no lasting changes in serum protein pattern, and marked re-calcification of bony lesions has not occurred. In view of the paucity of the objective evidence of improvement, it is prudent to regard the effects of I^{131} as palliative.

4. Mild radiation sickness occurred in about one-third of all cases.

5. Consideration may be given to treatment with I^{131} or RISA (*a*) when whole body irradiation is desired, (*b*) if the patient is not ambulatory or cannot be easily moved for x-ray therapy, (*c*) if local x-ray is inadvisable because painful areas are too numerous, and (*d*) if skin tolerance to roentgen rays has been exhausted.

6. RISA must be given by vein, but is more economical of the isotope, and the dose is below the level for which the Atomic Energy Commission requires hospitalization. I^{131} (as iodide) can be given by mouth. It is preferable to RISA if it shows selective localization in the lesions. Either will destroy the thyroid if its uptake is not blocked.

ACKNOWLEDGMENT: The authors are indebted to Drs. Herbert Schwartz and Theodore Spaet for electrophoretic analyses of the serum proteins, and to Mavis L. McCormic, M.S., for technical assistance.

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SUMARIO

Tratamiento del Mieloma Múltiple con Yodo Radioactivo y Seroalbúmina Yodada Radioactiva

Présentanse aquí los resultados terapéuticos en 9 casos de mieloma múltiple, tratados con radioyodo (I^{131}), administrado oralmente, y en 7 que recibieron seroalbúmina yodada radioactiva (SAYR) intravenosamente. En 4 del primer grupo y 3 del segundo, hubo alivio del dolor y aumento significativo de peso.

Por regla general, sobrevienen recidivas en tres o cuatro meses, pero el re-tratamiento suele ser eficaz. Debido a esto, la asistencia en cualquier caso dado suele consistir en una serie de tratamientos. En 2 enfermos, a la fecha de esta communicación se había estacionado aparentemente la rápida agravación de la enfermedad durante quince meses y nueve meses a continuación de la terapéutica con I^{131} y SAYR, respectivamente.

La anemia no mejoró, no hubo alteraciones duraderas en el patrón de la seroproteína y no se ha observado notable recalcificación de las lesiones óseas. Vista la escasez de los signos objetivos de mejoría, parece prudente considerar los efectos del I^{131} como paliativos.

La SAYR tiene que ser administrada por vía venosa, pero economiza más el isótopo, y la dosis queda por debajo de la cifra para la cual requiere hospitalización la Comisión de Energía Atómica de los E. U. A. El I^{131} es preferible a la SAYR si muestra localización selectiva en las lesiones. Cualquiera de los dos destruirá el tiroides si no se interrumpe la absorción.

Effect of Magnesium on the Response of Mice to Large Doses of Whole-Body Irradiation[1]

HENRY C. BLOUNT, JR., M.D.

THE PURPOSE OF the experiment to be described here was to study the effect of magnesium on the response of mice to large doses of whole-body roentgen irradiation.

It has been shown that a lowering of the body temperature of an animal results in a rise in the serum magnesium (1). On the other hand, a decrease in body temperature can be induced by the injection of magnesium (2). A reduction in body temperature with decrease in metabolic rate can increase the ability of an animal to withstand the lethal effects of whole-body roentgen irradiation (3, 4); conversely, with increased metabolic activity and elevation of body temperature, there is diminished resistance to irradiation (5). In the instance cited in which resistance to roentgen irradiation was increased, there was elevation in the serum magnesium level.

EXPERIMENTAL STUDIES

N.I.H. strain female mice weighing 23 ± 2 gm., varying in age from nine to twelve weeks, were used. All mice were given the same dose of radiation, which in the control group produced a mortality of 80 per cent in thirty days. The observation period following irradiation was thirty days, though one group was observed for one hundred and twenty days, with no fatalities after the thirtieth day. Care was taken in matching the mice in different treatment groups as to weight, age, and general condition. The animals were housed in groups of 12 to 30 per cage, depending upon the size of the cage. The diet consisted of Purina dog chow and water, which were available in the cage at all times.

Magnesium was given in the form of magnesium sulfate in aqueous solution. Dosages used were 5 mg., 10 mg., and 15 mg. administered intraperitoneally in 1 c.c. of water. Controls received 1 c.c. normal saline intraperitoneally. The 5 and 10 mg. doses produced no deaths, but in the group receiving 15 mg. there was a 30 per cent mortality due to the medication. The injections were given five minutes, plus or minus two minutes, before irradiation was started. Deaths due to magnesium sulfate occurred approximately thirty to sixty minutes after the injections, whereas there was an interval of several days before there were any deaths due to the irradiation.

During the period of irradiation the mice were confined in a circular plastic cage. Twenty mice were irradiated simultaneously, and each animal was housed in an individual compartment at the periphery of the cage, which rotated slowly, completing four revolutions during the period of irradiation. The mice in various treatment groups were distributed uniformly in the compartments of the irradiation cage.

A total of 625 r, measured in air and including back-scatter, was given to all mice. The r per minute output of the x-ray machine was carefully checked with a Victoreen ionization chamber prior to each period of irradiation. The tip of the ionization chamber was placed in the center of one of the compartments at the periphery of the cage, which was permitted to make a complete rotation during the irradiation test period. There was slightly less than 10 per cent variation in intensity between the highest and lowest point in the irradiation field; however, the rotation

[1] From the U. S. Public Health Service Hospital, Seattle, Wash. Accepted for publication in July 1954.

TABLE I: SUMMARY OF MORTALITY THIRTY DAYS AFTER ADMINISTRATION OF 625 r OF WHOLE-BODY ROENTGEN IRRADIATION

	Controls		5 mg. $MgSO_4$		10 mg. $MgSO_4$		15 mg. $MgSO_4$			
							Not including drug deaths		Including drug deaths	
	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive
Group 1	19	9	0	0	25	6	3	25	8	25
Group 2	16	8	16	7	14	9	5	10	19	10
Group 3	20	2	22	1	13	8	7	15	16	15
TOTALS	55	19	38	8	52	23	15	50	43	50
Per cent dead	74%		82%		70%		23%		46%	
X^2 as compared with controls	....		Not significant		Not significant		34.2 (highly significant)		12.3 (highly significant)	

of the cage during exposure gave uniform dosage to each compartment. Although there was still a slight difference between the intensity at the central and peripheral ends of each compartment, the variation was the same in each instance. The irradiation factors were as follows: 250 kv; 30 ma; 0.25 mm. copper plus 1.0 mm. aluminum added filtration; 70 cm. T.S.D.; 71 r per minute, plus or minus 1 r; 1.1 mm. copper half-value layer.

The results of the experiment are given in Table I. The mice that died as a result of the 15-mg. injections of magnesium sulfate were originally excluded in the evaluation. However, as these might be the weaker animals and all might have died later as a result of the irradiation, another evaluation was made combining the deaths due to both causes. It will be noted in Table I that, even including the deaths due to the drug, there is a highly significant difference in mortality between the group receiving 15 mg. magnesium sulfate and all other groups. No significant difference was observed in the mortality between the controls and those receiving 5 or 10 mg. of magnesium sulfate, nor was there a significant difference observed between those receiving 5 mg. and those receiving 10 mg.

The effect on rectal temperature produced by magnesium was studied in 20 white mice of unknown strain. The animals were similar in age and weight to those used in the irradiation study. The rectal temperatures were checked with a thermometer. Each dose of magnesium sulfate was given intraperitoneally in 1 c.c. of water. Controls received 1 c.c. of water intraperitoneally. Injections of 5 and 10 mg. magnesium sulfate and injections of 1 c.c. of water all produced falls in rectal temperature of approximately the same magnitude. The mice which were given 15 mg. of magnesium sulfate showed a consistently greater fall in temperature than did those receiving any of the other injections.

The explanation for the observed protective effect of the magnesium is uncertain. The fall in body temperature with decrease in metabolic rate might account for the observed results. In this study the range between effective and lethal dosage of magnesium sulfate is relatively narrow.

SUMMARY

The intraperitoneal injection of 15 mg. of magnesium sulfate in 1 c.c. of water produced a significant protective effect in the response of mice to whole-body roentgen irradiation. Injections of 5 and 10 mg. of magnesium sulfate failed to exert a significant protective effect as compared with controls. The results may be in part accounted for by a fall in body temperature and presumably also by a drop in metabolic rate.

ACKNOWLEDGMENTS: Dr. Eugene P. Pendergrass provided materials and equipment at the Hospital of the University of Pennsylvania for the pilot experiment in this study. Dr. George R. Krause permitted the use of equipment at Mt. Sinai Hospital in Cleveland, Ohio, for the major portion of the irradiation.

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SUMARIO

Efecto del Magnesio sobre la Respuesta de los Ratones a Grandes Dosis de Irradiación Total del Cuerpo

La inyección intraperitoneal de 15 mg. de sulfato de magnesio en 1 c.c. de agua produjo un notable efecto protector en la respuesta de los ratones a la irradiación roentgen de todo el cuerpo. Las inyecciones de 5 y 10 c.c. de sulfato de magnesio no ejercieron suficiente efecto protector, en comparación con los testigos. Cabe explicar en parte los resultados por una baja de la temperatura orgánica y presuntamente también por una baja del coeficiente del metabolismo.

Comparison of Hematologic Effects of Internally Deposited Radium and Plutonium in Dogs[1]

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THE EXPANSION of the atomic energy program and the widespread use of heavy radioactive elements in all areas of research have increased the need for data concerning the permissible total body burden of these elements. Current permissible body burdens are based upon data gathered from several sources. For heavy elements, the information on radium toxicity in man obtained from the luminous dial workers, and from individuals exposed to radium therapeutically or accidentally, serves as a base line (1–4). Permissible total body burdens of other heavy radioactive elements, particularly plutonium, have been arrived at by comparing their toxicity with that of radium in mice or rats and then extrapolating to man on the basis of the radium cases. The toxicity of plutonium has also been studied in a relatively small number of dogs. Thus, the permissible body burden of plutonium has been placed at 0.04 μc, while that for radium is 0.1 μc. Some doubt has arisen as to the reliability of the latter figure, since it has been found that some batches of luminous paints contained significant amounts of mesothorium and radiothorium.

A study is being made of the comparative effects of plutonium, radium, radiothorium, and mesothorium in adult beagle dogs. By using a species with a relatively long life span and a skeletal growth pattern generally similar to that of man, we hope to contribute more reliable animal data for extrapolation to human beings. The dose levels of the heavy radioelements which we are employing may produce immediate effects such as the acute radiation syndrome and hematologic changes. Benign and malignant bone disease, blood dyscrasias, and hepatic and renal disease are among the recognized delayed effects.

This report includes the hematologic alterations which are seen during the first year following injection of plutonium and radium. Results on dogs injected with radiothorium and mesothorium will be reported later.

TABLE I: AMOUNTS OF PLUTONIUM AND RADIUM ADMINISTERED AND AMOUNTS RETAINED AT SIX TO TWELVE MONTHS AFTER INJECTION

	Injected Dose		Retained Dose at 6–12 months
Dose Level	Plutonium (μc/kg.)	Radium (μc/kg.)	Plutonium and Radium (μc/kg.)
5	2.78	10.00	2.5
4	0.900	3.24	0.81
3	0.300	1.08	0.27
2	0.0955	0.344	0.086
1	0.0159	0.0572	0.0143

METHODS

Young adult male and female dogs were selected from a healthy pure-bred beagle colony maintained under optimal conditions. At the time of injection the males have an average weight of 10 kg. and the females of 8 kg. Skeletal maturity is verified by means of roentgenographic examination.

We employ five dose levels of each radioelement, estimated on a retained basis as follows: 2.5, 0.81, 0.27, 0.086, and 0.014 μc/kg. The injected doses are based on a 90 per cent retention of plutonium and 25 per cent retention of radium. The injected and retained amounts are given in Table I. The lowest dose level (0.014 μc/kg.) is considered to be equivalent to the current human total permissible body burden of radium, and the other doses are developed from it. The scale of five doses was designed to be sufficiently broad to give an accurate answer on a safe total body burden of radium and plutonium for the dog.

After three weeks of intensive control studies, including repeated hematologic

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determinations, the radioelement is injected intravenously in an amount sufficient to give the desired total body burden. Both plutonium-239 and radium-226 are injected as the plus 4 citrate. The animals are held in metabolism cages for twenty-one days and then released to

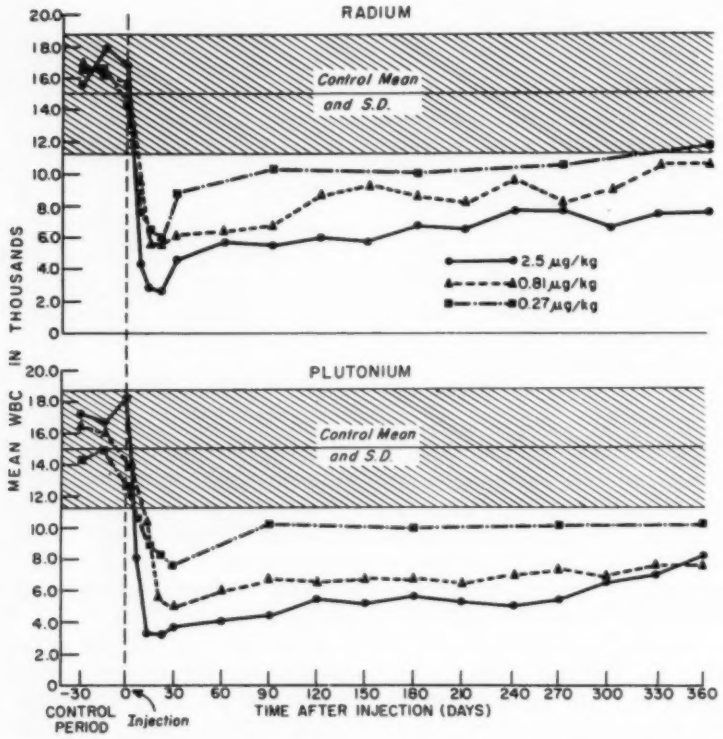

Fig. 1. The dose-time relationship of the leukocyte response to plutonium and radium.

red cell count, cellular indices, white cell count, differential leukocyte count, direct eosinophil count, platelet count, sedimentation rate, reticulocyte count, and icteric index. The hemoglobin is determined by the photoelectric method (Evelyn) and the volume of packed red cells by the Wintrobe hematocrit tube. In order to increase accuracy, erythrocytes, leukocytes, eosinophils, and platelets are counted in duplicate on at least two different dilutions by two different observers. Eosinophils are counted by a modified Randolph method and platelets by the Rees-Ecker method. Differential counts are made on coverslip preparations stained with May-Grünwald-Giemsa. A minimum of 400 cells is differentially counted on each preparation.

The blood is drawn from the jugular vein of the dog at approximately the same

standard runs. Retained burden is verified by total body gamma counting (5), breath radon measurements (6), and urinary and fecal assays (7). Biological effects are detected through clinical observations and hematologic, biochemical and radiologic studies. The experimental animals are injected in groups of five, with one animal at each dose level plus one control animal for each experimental group. It is planned to inject twelve groups of dogs with each radioelement.

The hematologic determinations include hemoglobin, volume of packed red cells,

time each morning and prior to feeding. Three control hematologic determinations are made at approximately weekly intervals during the month prior to injection on each experimental animal, so that post-injection values may be compared to the animal's own control values as well as to control values for the colony as a whole. The latter have been established on 85 normal adult beagle dogs of both sexes, of approximately the same age.

The frequency of post-injection hematologic determinations depends on the amount of radioisotope injected. A few determinations were made on high-level plutonium and radium dogs at intervals during the first twenty-four hours and at two and four days. In general, counts are made on a few experimental groups with each radioelement at weekly intervals for the first month and on all 0.81 and 2.5 μc/kg. dogs at monthly intervals thereafter, on 0.27 μc/kg. dogs every three months, and on 0.014 and 0.086 μc/kg. dogs every six months. More frequent determinations have been made on several groups of dogs receiving the two lowest dose levels to ascertain whether there were any early hematologic changes.

RESULTS

The only significant radiation effects that we have detected during the first year have been hematologic, except for the development, in one dog, of the acute radiation syndrome approximately three weeks after receiving a retained dose of 2.5 μc/kg. of plutonium. This animal recovered and has since remained well. The mean hematologic values obtained on control dogs are presented in Table II. No sex difference was noted in any of the values. The hematologic data on five groups of dogs injected with plutonium and four groups injected

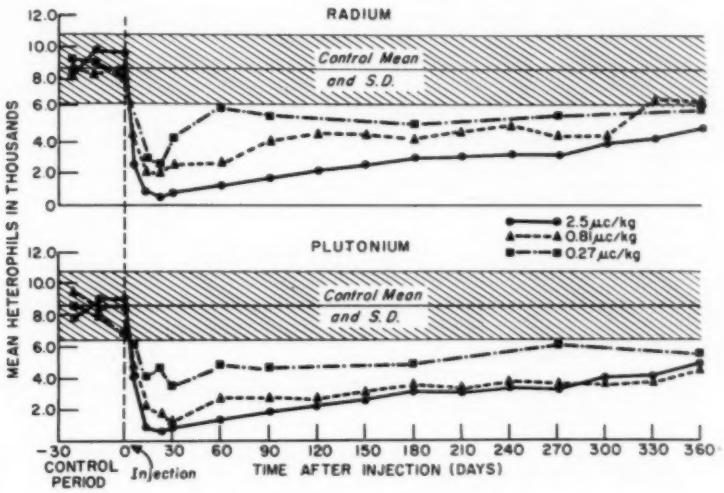

Fig. 2. The dose-time relationship of the heterophil response to plutonium and radium.

TABLE II: NORMAL VALUES OF BLOOD ELEMENTS FOR 85 CONTROL ADULT BEAGLE DOGS

	Mean	S. E.
Erythrocytes ($\times 10^6$/mm.^{3})	7.16	0.79
Volume of packed red cells (ml./100 ml.)	49.0	0.46
Hemoglobin (6 gm./100 ml.)	16.4	0.18
Reticulocytes (per cent)	0.47	0.04
Leukocytes ($\times 10^3$/mm.^{3})	15.0	0.40
Heterophils ($\times 10^3$/mm.^{3})	8.56	0.26
Lymphocytes ($\times 10^3$/mm.^{3})	4.26	0.13
Monocytes ($\times 10^3$/mm.^{3})	1.00	0.05
Eosinophils ($\times 10^3$/mm.^{3})	0.87	0.06
Platelets ($\times 10^3$/mm.^{3})	423.0	12.80
Sedimentation rate (ml./hr.)	3.6	0.68
Direct eosinophil count (10^3/mm.^{3})	0.46	0.02
Icteric index	4.5	0.15

with radium are summarized below for the first year after injection.

No significant hematologic alterations have been observed during the first year in control dogs or in animals receiving retained amounts of 0.086 or 0.014 μc/kg. of plutonium or radium. With higher doses, mal values for the remainder of the first year (Fig. 1).

The heterophil response is plotted for 0.27, 0.81 and 2.5 μc/kg. dogs in Figure 2. It may be seen from these curves that the leukocyte depression which occurs during the first month following injection is due

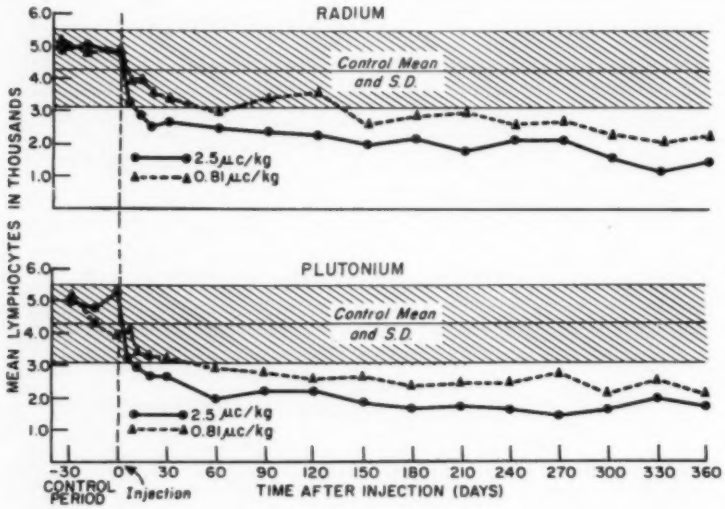

Fig. 3. The dose-time relationship of the lymphocyte response to plutonium and radium.

the degree of depression of leukocytes and platelets is roughly proportional to the amount of radioelement retained in the body (Figs. 1–4).

A significant leukopenia developed in dogs which received retained amounts of 0.27, 0.81 and 2.5 μc/kg. of radium and plutonium (Fig. 1). There was no significant difference in the degree of leukocyte depression between plutonium and radium animals at comparable dose levels. There were no changes in white cell values at six, eight, ten or twenty-four hours or at two and four days in any of the highest level plutonium or radium dogs studied at this time. At one week after injection of either radioelement, the total leukocyte counts fall to one half of pre-injection values and minimal values occur in all three dose levels at twenty-one to thirty days. Leukocyte numbers then increase slowly during the next thirty to sixty days, after which time they plateau at subnormainly to a fall in the numbers of heterophils. This cell type, as in man, constitutes over half of the circulating leukocytes (Table II). The heterophil decrease is accompanied by a similar decrease in the numbers of eosinophils and monocytes. There is a rise in granulocytes and monocytes after thirty days to values of about one-third to one-half the pre-injection values by the end of the three hundred and sixty-day period of study. There was no significant difference in granulocyte response in time or degree between the plutonium and radium dogs.

Although a depression in granular leukocytes is seen in the 0.27 μc/kg. dogs, the lymphocyte values of these dogs remained within normal limits during the three hundred and sixty days of observation. A depression of lymphocytes is seen in the animals receiving the two highest dose levels (0.81 and 2.5 μc/kg.). The lymphopenia, however, is less marked and more

variable in individual dogs than is the heterophil depression. The mean absolute lymphocyte count is plotted for the 0.81 and 2.5 μc/kg. dogs in Figure 3. There is slight depression in lymphocytes during the first thirty days (period of maximum granulocytopenia). The lymphocyte numbers continue to fall, with a maximal lymphopenia by the end of the three hundred and sixty-day period of observation. The lymphocytes of 2.5 μc/kg. plutonium or radium dogs fall to about one-third of their pre-injection values by this time. A minimal and questionably significant lymphopenia is seen during the last half of the first year in the 0.81 μc/kg. dogs, with mean values just outside the standard deviation of the colony (Fig. 3).

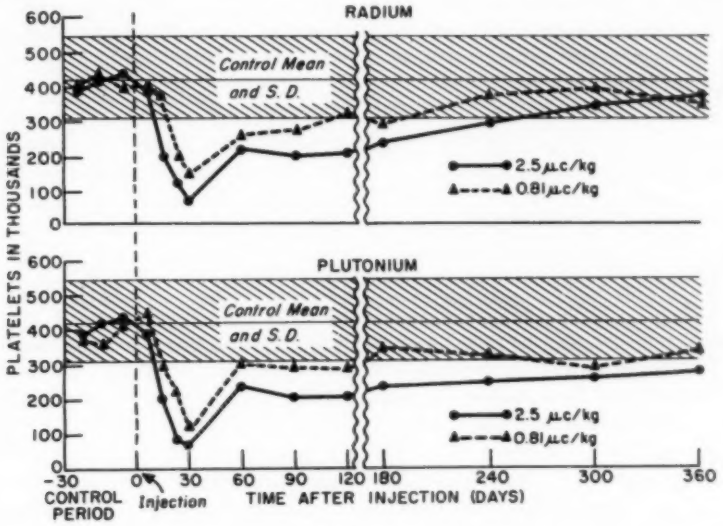

Fig. 4. The dose-time relationship of the platelet response to plutonium and radium.

No alterations in blood platelets are seen in the 0.27 μc/kg. dogs. The platelet response for those receiving 0.81 and 2.5 μc/kg. is plotted in Figure 4. A thrombocytopenia appears in two to three weeks following injection and is maximal at thirty days. A return toward normal values is seen at sixty days and the levels of these blood elements remain within normal limits for the remainder of the first year. There is no significant difference between the degree of thrombocytopenia in the radium and plutonium animals.

A variable but significant depression in erythrocyte values was seen in 4 of the 5 dogs receiving the 2.5 μc/kg. dose of plutonium. The volume of packed red cells fell from a pre-injection mean value of 49.9 ml./100 ml. to a minimum mean value of 34.9 ml./100 ml. (a mean decrease of 30 per cent). Only 1 of the 4 animals receiving 2.5 μc/kg. radium has shown this degree of depression of the hematocrit. The mean change in volume of packed red cells in the radium dogs is from 48.0 ml./100 ml. to 43.5 ml./100 ml. (a mean decrease of 12 per cent). The moderate anemia seen in the high-level plutonium dogs is normochromic and normocytic in type and appears in the individual dogs from thirty to one hundred and eighty days following injection. The anemia is brief in duration, with a return to normal values within one month. A rise in sedimentation rate and a slight reticulocytosis accompany the anemia. There has been no change in icteric index.

Morphological alterations have been observed in the leukocytes as early as two weeks in animals receiving the 0.81 and

2.5 μc/kg. of plutonium or radium. These consist mainly in the appearance of giant hypersegmented heterophils. However, atypical lymphocytes, *i.e.*, forms with increased basophilia and vacuoles in their cytoplasm or increased amounts of cytoplasm, as well as lymphocytes with notched or indented nuclei, are occasionally seen in the high-level dogs. Toxic and atypical forms of heterophils, as well as immature forms, were noted in the dog which developed the acute radiation syndrome. During periods of thrombocytopenia, giant platelets are also found in the blood.

DISCUSSION AND SUMMARY

Following the intravenous administration of plutonium-239 about 90 per cent of the injected dose is retained in the body. Most of this retained amount is fixed in bone. It is concentrated on periosteal and endosteal surfaces and thus relatively large amounts are found in cancellous as compared to compact bone. When radium-226 is injected intravenously, approximately 25 per cent of an injected dose is retained in the body. It is deposited diffusely in bone according to the pattern of calcium. Thus, according to radioautographic findings (8), there would be less alpha particle bombardment of hematopoietic tissue in the radium dogs than in the plutonium dogs. However, since we inject amounts of these radioelements which will give the same long-term retention in the body, and the retention of radium is 25 per cent in contrast to a 90 per cent retention for plutonium, the initial amount in the radium dogs is between three and four times higher than that in the plutonium animals.

There have been a number of reports on the hematologic effects of ionizing radiation from external and internal sources (reviewed by Jacobson *et al.*, 9). The hematologic response to parenteral administration of plutonium and radium has been reported for mice, rats, rabbits, beagle puppies, and mongrel dogs (10–13). To the best of our knowledge, the experiment that we are conducting is the first to use a large number of adult pure-bred beagles from a colony maintained under optimal conditions.

Thus far the hematologic response that we have noted in our dogs, as evidenced by leukocyte or platelet depression, is similar in degree when comparable amounts of plutonium and radium are retained in the body. One explanation for the difference in hematologic response between the two elements in smaller animals noted by Jacobson and Simons (10) may be related to the fact that injected rather than retained amounts were compared. Only in the erythrocyte response have we noted any greater effect on the hematopoietic system with plutonium during the first year. The reason for the more consistent depression of red cell values in the 2.5 μc/kg. plutonium dogs is not apparent at the present stage of our studies. One way in which we hope to elucidate the mechanism of the alterations in the blood cells following plutonium and radium injection is by examining the bone marrow of serially sacrificed dogs.

Although the irradiation of lymphatic tissue is small with the amounts of radioisotopes used, the blood lymphocytes decrease significantly in number during the first year in dogs carrying 2.5 μc/kg. of plutonium or radium. Since the pituitary-adrenal system is not directly irradiated, this suggests that a stress reaction may occur which is mediated through some substance released by irradiation injury. We plan to determine adrenocortical steroid levels on the blood of 2.5 μc/kg. dogs to ascertain whether there is a stimulation of the adrenal cortex.

We have endeavored to compare the hematological changes we find in our dogs with the published reports from other laboratories in which dogs as well as other species were used. In view of the difference in experimental design we do not feel that any meaningful comparisons can be made at this time. For information on other species, the reader may consult the reports of Jacobson and Simons (10), Finkle *et al.* (11), Painter *et al.* (12), and Boyd *et al.* (13). In general, the studies

reported here indicate that there is hematologic damage following injection of plutonium or radium at doses lower than heretofore reported for dogs or other species.

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SUMARIO

Efectos Hematológicos de los Depósitos Internos de Plutonio y Radio

Preséntanse aquí, para el primer año consecutivo a la inyección, los efectos hematológicos de cantidades graduadas de plutonio y de radio administradas intravenosamente en una sola dosis a perros sabuesos adultos. Los animales recibieron 0.014, 0.086, 0.27, 0.81 y 2.5 μc/kg. como dosis de retención. Las dosis inyectadas se basan en una retención de 90 por ciento de plutonio y 25 por ciento de radio a los seis meses, para cuya fecha ambos radioisótops se hallan fijados principalmente en el hueso.

En los perros que recibieron los tres regímenes más altos de dosis se presentó en término de diez días a dos semanas una leucopenia que varió de moderada a notable. La baja de leucocitos alcanzó su máximo en un período de tres semanas a un mes, debiéndose principalmente a disminución de los granulocitos. Las fórmulas leucocitarias se elevaron luego lentamente, pero permaneciendo por debajo de los límites normales durante todo el resto del año. En los perros que recibieron 2.5 μc/kg. de plutonio y radio (dosis de retención), hubo una disminución leve, pero significativa, de los linfocitos, observándose las cifras mínimas al final del año. Descubrióse una trombocitopenia pasajera en los animales que recibieron los dos regímenes más altos de plutonio y radio.

Según demuestra la baja de los leucocitos y los trombocitos, la respuesta hematológica en estos perros es semejante en intensidad y fecha de aparición cuando se retienen en el organismo cantidades comparables de plutonio y radio. En los perros que recibieron el régimen posológico de 2.5 μc/kg. de plutonio, observóse una baja más constante de las cifras hematocíticas que en los que recibieron 2.5 μc/kg. de radio. En general, obtuviéronse pruebas de que el sistema hematopoyético experimenta lesiones tempranas a continuación de la inyección de plutonio o radio a dosis más bajas que las descritas hasta ahora para perros u otras especies de animales.

The Relative Biologic Effects of X-Rays and Beta Rays[1]

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INVESTIGATIONS of the biologic effects of different types of ionizing radiations suggest that quantitative differences in response occur even though identical amounts of energy are absorbed per unit volume of tissue. Since the development of technics for the treatment of cancer and other diseases with radioactive isotopes, information regarding the relative biologic efficiency of the emitted beta particles and x-rays is required to utilize properly the knowledge that has been acquired by experience with x-rays. We, as well as others (9), have been impressed with the striking tolerance of normal tissue for beta irradiation. The dosage that may be given without producing necrosis or other serious reactions seems to be many times greater for beta rays than for 200-kv x-rays.

Most of the data in the literature regarding relative biologic efficiency deal with alpha rays, neutrons, gamma rays, and supervoltage x-rays. Among the reports comparing beta rays and x-rays there is a lack of uniformity in results obtained. Stapleton and Zirkle (15) compared the efficiency of beta rays from P^{32} with the gamma emission from Ta^{181} in inhibiting the hatching of *Drosophila* ova and found no significant difference. Using the same material, Zirkle (17) compared 200-kv x-rays and P^{32} beta rays and found the latter to be less efficient by a factor of 0.64. Snyder and Kisieleski (13), studying the twenty-day LD 50 dose in mice for the beta emission of Na^{24} and 200-kv x-rays, reported a ratio of 0.7. Evans and Quimby (4), using Na^{24} beta rays and 200-kv x-rays to produce lymphopenia in mice, reported the former to be less efficient, the ratio of beta to x-rays having the value 0.66. Taking the graying of hair in mice as a biological end point, Austin *et al.* (1) compared 17 Mev electrons with 100-kv x-rays and found a ratio of 0.6. Gärtner (6) compared the effects of fast electrons from a 6-Mev betatron and 90-kv x-rays on cultures of chicken heart fibroblasts and demonstrated a relative electron efficiency of 0.51.

Friedell *et al.* (5) reported comparable skin reactions following physically equivalent doses from Sr^{90}, RaD and E, and Ru^{106}, and stated that these reactions approximated the skin effects produced by a 44-kv Philips contact unit. Wirth and Raper (16) found the threshold erythema dose on human skin for P^{32} to be 813 rep, while Low-Beer (11) estimated that a dose of 143 rep from P^{32} produced a similar reaction. Crabtree and Gray (3) found no quantitative differences between beta, gamma, and roentgen rays in efficiency for inhibition of anaerobic glycolysis in the rat retina.

We are presenting a preliminary report of our study of the relative biologic effects of medium voltage (120 and 200 kv) x-rays and beta rays emitted by P^{32}. Because radiations of different energies usually differ as to range in tissue, it was important to select a test object with sufficiently small dimensions so that uniform distribution throughout the volume could be obtained, thus eliminating the possibility that the various radiations had significantly different sites of action. Dosimetry by use of a scintillation counter indicated that a fairly uniform dosage occurred throughout a 1.0 mm. thickness of tissue placed between two opposing surfaces covered with P^{32}. Because measurements of the rabbit's ear indicated an average thickness approximating 1.0 mm., this was considered to be a suitable tissue.

[1] From The Edward Mallinckrodt Institute of Radiology, Washington University School of Medicine, Saint Louis, Mo. Supported by the U. S. Atomic Energy Commission (Contract AT(11-1)-85, Project 3). Presented at the meeting of the Association of University Radiologists, St. Louis, Mo., May 1954. Accepted for publication in July 1954.

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PHYSICAL ASPECTS

The dose of x-rays was measured with a Victoreen ionization chamber. Because of the fact that the thickness of tissue traversed by the radiation was only approximately 1.0 mm., no depth-dose corrections were required. The beta-ray dosimetry was considerably more complicated and required knowledge of both the dose rate at the surface of the plaque and the depth dose distribution in a tissue-equivalent medium. These data were obtained on the basis of the following considerations. It was assumed that the intensity of the radiation emitted by a plane beta-ray source infinitely thick, in a direction perpendicular to the plane of the source, decreased according to an exponential law. Thus, the intensity of radiation at distance x, in a direction perpendicular to the plane of the source was assumed to be

$$I_{\infty}(x) = \frac{I_0}{2} \exp(-\mu x)$$

where I_0 is the intensity of radiation in an infinitely thick source containing a uniform concentration of activity and μ is an "effective" absorption coefficient. This is assuming that the absorption coefficient of the radiations in the source is the same as the absorption coefficient in the absorber placed between the source and the point where the intensity of radiation is measured. The intensity of radiation from a source of thickness s, containing the same concentration of activity was derived as follows:

$$I_s(x) = I_{\infty}(x) - I_{\infty}(x + s), \text{ or}$$

$$I_s(x) = (1 - \exp(-\mu s)) \frac{I_0}{2} \exp(-\mu x)$$

which is proportional to $exp\ (\mu x)$. The validity of this assumption was verified experimentally by determining the depth doses of the beta radation emitted by sources of P^{32} of various thicknesses immersed in water. This was accomplished by using a scintillation counter beta-ray probe, which has been described elsewhere (10). The measurements thus performed showed that the depth-dose curve was exponential for source thicknesses varying from 20 mg./cm.^{2} to 1,000 mg./cm.^{2}. The effective absorption coefficient for P^{32} gamma rays, in water, was found to be 9.55 cm.^{2}/gm. Thus, the intensity of radiation at the surface of a 20 mg./cm.^{2} thick P^{32} plaque was given by:

$$I_{s(0)} = \frac{I_0}{2} (1 - \exp.(-\mu s))$$

I_s = dose at the surface of a source having a thickness of s,
I_0 = intensity of radiation in an infinitely thick source,
μ = absorption coefficient,
s = thickness of the source, or

$$I_s = I_0 \frac{1 - \exp - (0.02 \times 9.55)}{2}$$

$$= 0.087\ I_0$$

The intensity of radiation at the surface of a 20 mg./cm.^{2} source was thus 8.7 per cent of the dose in an infinitely thick source having the same concentration of activity.

I_0 could be calculated, knowing the concentration of activity and average energy of the beta rays. Assuming that 1 rep corresponded to a dissipation of energy of 83.3 ergs per gram of tissue-equivalent material and that the average energy of P^{32} beta rays was 0.695 Mev, then it could be shown that

$$I_0 = 29.6 \text{ rep per min. per mc/gm.}$$

Because the distribution of the x-radiation through the ear section was practically homogeneous, it was desirable to obtain an equally homogeneous distribution of beta rays. This was accomplished by placing the rabbit ear between two opposing P^{32} plaques. The total beta-dose distribution was equal to the sum of the contributions from each source. This distribution is shown in Figure 1. The surface dose contributed by each plaque was taken as 100 per cent. The dose was fairly uniform across the 1.0 mm. section of ear. It should be noted that the surface dose obtained with both plaques in place was 137.5 per cent of the dose delivered by a single plaque, the average dose through the ear being approximately 130 per cent.

The plaques used to deliver the beta

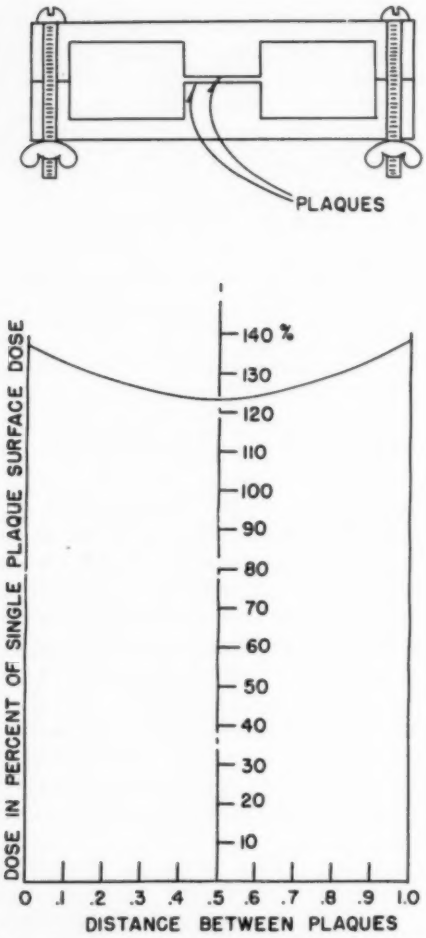

Fig. 1. Beta-dose distribution in the rabbit's ear from two opposing P^{32} plaques.

radiation were filter paper disks 2 cm. in diameter and 20 mg./cm.^{2} thick, which had been soaked in a solution of P^{32}. These plaques did not correspond rigorously to an infinite plane source. However, the deviation was only apparent at the outer edges of the disk, the inner area, approximately 1.5 cm. in diameter, delivering virtually the same surface dose as an infinite plane source. At the edges of the plaque, the surface dose was a little less than 50 per cent of the dose at the center and fell rapidly to zero. However, the distribution of activity over the surface of the plaque was reasonably uniform, as indicated by autoradiographs. A concentration of 2 mc of P^{32} per square centimeter corresponded to a surface dose of 258 rep per minute at the surface of the plaques. With two plaques facing each other and separated by 1.0 mm., the surface dose was 355 rep per minute, a value somewhat higher than the x-ray output. The plaques were often used over a period of two weeks, at the end of which time the surface dose amounted to only 175 rep per minute.

METHODS AND RESULTS

A circular area, 2 cm. in diameter, in the mid-portion of the ear of white rabbits was irradiated with 200-kv x-rays having a h.v.l. of 1.0 mm. Cu at a focus-skin distance of 25 cm., or with 120-kv x-rays filtered by 1.0 mm. Al. Tissue-equivalent material was placed under the rabbits' ears in order to control back-scatter. The beta irradiation was delivered using the P^{32} plaque described above. The first series of rabbits was irradiated with 120-kv x-ray and P^{32} in doses varying from 750 to 7,500 r, in order to observe the biologic reactions and select a suitable end point. Because a variation in the biologic response was noted in rabbits receiving the same dose of radiation, it was felt that the most reliable control was the other ear of the same rabbit. The position of the irradiated site on the ear also influenced the biologic effect, so that it seemed important to compare similar areas. The biologic effects produced in this dose range varied from partial epilation to necrosis and perforation. When the reactions became severe, with ulceration and exudation, it was increasingly difficult to detect quantitative differences. The easiest recognizable end point was the production of a moderately intense dry erythema.

The irradiation rate and overall time of irradiation were roughly comparable, being 200 to 250 r per minute for both types of x-rays and from 175 to 355 rep per minute for the P^{32} beta rays. The erythema following 2,000 to 3,000 r of x-irradiation first appeared eighteen to twenty-two days

following the irradiation, reached its maximum intensity on the twenty-fifth to the thirtieth day and then gradually faded, leaving a white atrophic area after forty-five to sixty days.

In a second series of 12 rabbits, only one area on each ear was irradiated. All animals in this series were given 2,000 r to a 2-cm. diameter circular area on the left ear with a 120-kv x-ray machine, with 1 mm. Al filtration at 20 cm. distance. An area of similar size and position on the right ear was given 2,000 rep from a double P^{32} plaque. None of the animals exhibited any grossly detectable reactions from the P^{32} irradiation, while the x-rays produced a moderate erythema with dry white scaling in most animals, and in a few dry white scaling and epilation without a definite erythema.

A third series of 13 rabbits was irradiated with a 200-kv x-ray machine with 1 mm. Al filtration and 20 cm. focus-skin distance. Seven animals were given 3,000 x-ray r to the left ear and 3,000 beta rep from P^{32} to the right ear. The remaining 6 were given 6,000 beta rep to the right ear and 3,000 x-ray r to the left ear. Three thousand x-ray roentgens delivered in one dose resulted in the production of a moderate dry erythema associated with dry scaling in every rabbit in this group. The erythema usually appeared from the eighteenth to the twenty-fourth day, and in a few rabbits superficial ulcerations developed. In only 1 of 7 animals was there any observable reaction on the ear that received 3,000 r with the P^{32} plaque. This 1 animal exhibited a faintly detectable erythema that was much less than on the opposite x-irradiated ear. In the group of 6 rabbits receiving 6,000 r from the P^{32} plaque, a moderate dry erythema developed after eighteen to thirty days, but in every instance the reaction was slightly less intense than that in the ear that received only 3,000 r using 200-kv x-rays.

DISCUSSION

From the observations just cited, it appeared that the beta rays emitted by the P^{32} plaque were slightly less than half as efficient as x-rays of moderate voltage in producing an erythema on a rabbit's ear. Physical measurements indicated that there was no significant difference in the distribution of ionization throughout the 1 mm. thickness of tissue. Some variation in the radiation rate occurred because of physical decay of the P^{32}. However, most of the data obtained with x-rays has indicated very little dependence of biologic effect on differences in rate of this magnitude.

It has been suggested that biologic effects depend not only on the amount of energy absorbed per unit volume, but also on the way in which it is distributed within this volume. If this is true, differences in linear energy loss might account for quantitative differences in the biologic effects of different types of radiations. Zirkle (18) has demonstrated that the biologic effectiveness of a radiation often increases as the linear energy loss increases. This relationship does not seem to be proportional, since it has been demonstrated that 200-kv x-rays are 1.4 times as effective as 24-Mev x-rays, while the linear energy loss is ten times greater (7).

Since the average energy of the secondary electrons from 200-kv x-rays is in the neighborhood of 14 kev, while the average energy of the beta rays emitted by P^{32} is almost 600 kev (2), a marked difference in linear energy loss does exist. According to Gray (7) differences in linear energy loss are minimal beyond the 2-Mev range. Moritz and Henriques (12) studied skin effects, using different isotopes having beta-ray emission with energies ranging from 0.17 to 2.2 Mev. They found that if the dose was calculated at the level of the basal layer of the epidermis, the amount required for the production of recognizable injury was relatively constant. Haas, Harvey, and Laughlin (8) found that the efficiency of 23-Mev x-rays from the betatron compared with 200-kv x-rays was approximately 0.56 for the production of an erythema on rabbit skin. The linear energy loss of the secondary electrons of the betatron and that of P^{32} beta rays are not greatly

different, and this may account for the similarity of biologic efficiency.

As emphasized by Haas and others, the relative biologic efficiency may vary according to the biological end point used, so that one must be circumspect in extrapolating biologic efficiency ratios determined by animal experiments to man.

SUMMARY

1. The relative biologic efficiency of 200-kv x-rays and the beta rays of P^{32} in producing erythema on a rabbit's ear was studied.

2. With equal doses and similar physical distribution in tissue, the beta rays of P^{32} were found to be slightly less than one-half as efficient as 200-kv x-rays in producing erythema on the rabbit's ear.

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SUMARIO

Los Relativos Efectos Biológicos de los Rayos X y los Rayos Beta

A fin de determinar la relativa eficacia biológica de los rayos X de voltaje moderado y los rayos beta del P^{32}, hiciéronse estudios del eritema producido por las dos clases de irradiación en la oreja del conejo. Se escogió este objeto de ensayo por ser sus dimensiones suficientemente pequeñas (1.0 mm. de grueso) para obtener distribución uniforme de la irradiacion, eliminando así la posibilidad de que las distintas radiaciones encontraran sitios de acción significativamente distintos.

Con dosis iguales y similar distribución física en los tejidos, los rayos beta del P^{32} mostraron una eficacia ligeramente menor que la mitad de la de los rayos X de 200 kv en la producción de eritema en la oreja del conejo.

Intravenous Urography Using Mixtures of Radiopaque Agents

BENEDICT R. HARROW, M.D.

IN RECENT YEARS increasing efforts have been made to produce intravenous urograms that rival retrograde films. Since some of the organic iodides differ in their mode of excretion, it seemed reasonable that combinations of two radiopaque agents might produce a higher concentration of iodide in the urine without an increase in the total amount of medium injected. Diodrast and Neo-Iopax were selected, since their mechanisms of excretion are entirely different. Most of the Neo-Iopax reaches the urine by glomerular filtration, as Smith (16, 18) demonstrated in 2 patients. In the usual dosage, most of the Diodrast (about 70 per cent) is secreted by the convoluted tubules and only 30 per cent by filtration, although for a few minutes after injection filtration is higher, depending directly on the plasma levels.

At first the Diodrast and Neo-Iopax were injected at different times in separate syringes, but after suitable tests it was found that the contrast substances could be safely combined in the same syringe. Thirty consecutive adult pyelograms were obtained with 15 c.c. of 35 per cent Diodrast mixed with 15 c.c. of 50 per cent Neo-Iopax, injected slowly over a five- to six-minute period. The films were compared with numerous others obtained by exactly the same technic with 30 c.c. of 35 per cent Diodrast or 30 c.c. of 50 per cent Neo-Iopax. A slight but definite increase in density of the roentgen shadow was noted when the mixture of the two iodides was used.

Another advantage of the mixture, besides the increase in x-ray density, has also become apparent. It has proved to be safe and to cause very few minimal side-reactions, less than are observed with the unmixed individual drugs. Mild arm pain (vein cramps) still resulted, undoubtedly due to the Neo-Iopax. Nausea and a sensation of warmth occurred in a mild degree. No severe reactions such as vomiting, syncope, or urticaria were produced. At present, higher concentrations and larger amounts of one or both drugs are being used to determine which produces the greatest increase in density with the minimum of side-reactions.

Even these large quantities can be given slowly without producing severe arm cramps. If 50 per cent Neo-Iopax is used alone, it is usually injected rapidly to avoid vein irritation. With the mixtures, this is no longer necessary. It is felt that a slow injection will reduce the incidence of severe shock-like complications, although there is no definite proof for this statement. Routine rapid injections are not necessary, even though some workers have claimed an increase in urine concentration by this method (14). Fairly severe reactions have occurred with rapid injections of 50 c.c. of 70 per cent Urokon (3). Barry and Rose (2) observed two extremely severe shock reactions in a series of 1,160 rapid injections of 25 c.c. of 70 per cent Urokon and still another was recorded by Porporis *et al.* (11), while Zink (20) had one among 350 cases.

So far, in 12 patients, combinations of 20 c.c. of 40.5 per cent Diodrast and 30 c.c. of 50 per cent Neo-Iopax, or 30 c.c. of 35 per cent Diodrast and 20 or 30 c.c. of 50 per cent Neo-Iopax, have been given intravenously over the same five- to six-minute period. These amounts proved to be well tolerated and a still further increase in x-ray density of the urinary tract resulted. In a few patients, however, doubling the usual dosage of Diodrast (60 c.c. of 35 per cent) produced the same increase in density.

In 30 adult office patients, 25 c.c. of 70 per cent Urokon injected in five minutes

[1] From the Department of Urology, Mercy Hospital, Miami, Fla. Accepted for publication in July 1954.

were used for urography. A much greater density was obtained than with 25 c.c. of 30 per cent Urokon, 30 c.c. of 35 per cent Diodrast, 30 c.c. of 50 per cent Neo-Iopax, or smaller quantities of the mixture. The density was even greater than with larger quantities of the mixed solutions, although the molecular load of 70 per cent Urokon was considerably less (due to its higher molecular weight). There were, however, several minor drawbacks to the use of 70 per cent Urokon. In 8 patients a trace protein reaction to the heat and acid test on centrifuged urine was present immediately following intravenous pyelography, but this trace was absent when rechecked from one to three days later. A moderate antecubital thrombophlebitis developed in 3 patients several days after urography and may have been present in others who were not specifically examined for this complication. Moderate arm pain was frequent, but no leakage outside the vein occurred in any of the patients in this series. No severe reactions developed in this group of 30 cases, and only 2 patients had mild urticaria. Mixtures of Urokon and Neo-Iopax may circumvent these disadvantages, but careful testing for compatibility and safety will be necessary before using this solution. The mode of Neo-Iopax excretion should also be verified, since it was determined on only 2 patients, and since other clinical conclusions on glomerular filtration in obstructed kidneys have been supported by these data (6). The use of 50 c.c. of 30 per cent Urokon furnishes close to the same molecular load as 25 c.c. of 70 per cent Urokon and may prevent some of the aforementioned disadvantages.

It is of interest that with the use of 70 per cent Urokon a marked pseudoproteinuria occurred. In all patients with good renal function, a 4+ precipitate reaction resulted with sulfosalicylic acid, but if the urine was diluted with water from one to four times, no precipitation occurred. The precipitation is due to a direct chemical combination of reagent and Urokon only when the iodide is present in high concentrations. It can be formed by adding the sulfosalicylic acid to 70 per cent Urokon (or 35 per cent Diodrast; not to 50 per cent Neo-Iopax), but only if the Urokon is undiluted.

MAXIMUM URINE MOLECULAR CONCENTRATION

It became evident in this study that x-ray density was not directly proportional to actual urine iodide concentration. The x-ray density depends not only on the urine concentration but also on the amount of filling of the urinary tract structures. The concentration of the organic iodides in the urine was limited because of an osmotic diuresis. Increasing the intravenous load of the drug resulted only in increased urinary output. In young adults, whose urine specific gravity reached at least 1:030 just before intravenous pyelography, the urine flow before urography was less than 0.5 c.c. per minute. This was calculated by having the patients retain urine over a certain number of hours before pyelography and then measuring the amount. All patients voided before urography and again forty-five to sixty minutes after the intravenous injection, complete emptying of the bladder being confirmed by post-voiding films. The larger amounts of mixtures and 25 c.c. of 70 per cent Urokon caused a 1.5 to 3.5 c.c. urine flow per minute. Smaller amounts of contrast substance produced a decreased urine outflow, while larger amounts of iodides resulted only in increased diuresis, with no greater urine concentration. This fact about urine concentration was easily confirmed by recording specific gravity values. The 25 c.c. of 70 per cent Urokon produced a specific gravity from 1:064 to 1:074 in young patients who concentrated to 1:030 before urography, while 50 to 60 c.c. of the mixture resulted in a specific gravity of 1:054 to 1:064. Further increases in Urokon, or mixtures, raised these values only one to two units, probably because a slightly higher but not maximum concentration was maintained in the last fifteen-minute period of the forty-five- to sixty-minute collection. Specific gravities with 30 c.c. of

the mixture showed a decrease in values, probably because the maximum concentration had been reached for only a five- to ten-minute period and tapered off considerably toward the end of the procedure. Keates demonstrated that, even with small amounts of 35 per cent Diodrast (10 c.c.), the urine iodide concentration measured in ureteral specimens was maximum, at least for a short period, and was identical to that produced with 20 c.c. of 35 per cent Diodrast or 20 c.c. of 70 per cent Diodrast (7). He also showed that the larger quantities of contrast substances increased the diuresis but not the urine concentration (8).

The roentgen density increases with the larger amounts of the agent because the greater diuresis at high concentration aids in filling the urinary tract structures to a greater width and depth. Although the lesser amounts of drug produce the greatest possible urine concentration for a short time, the diuresis is less and it is more difficult to apply compression at the proper moment and produce complete filling of the calyces. In comparing x-ray densities, there are many variables that cannot be controlled and that result in discrepancies (15). Recently one investigator arrived at the exact antithesis of the other investigators (2, 9, 11) when two separate urograms were obtained on the same patients with separate drugs (8). This difference perhaps results from factors such as nonuniform use of compression by different technicians.

The osmotic diuresis occurring with these agents undoubtedly follows closely the results obtained by Rapoport *et al.* with other diuretics, including P.A.H., which is excreted in the same manner as Diodrast. They found that increasing the load of any osmotic diuretic in hydropenic man increases the urine flow, with an actual decrease in the urine concentration of the drug. Total osmolarity falls from a maximum of 1.4 osmols to 0.7 osmols, at urine flows of 3 c.c. per minute. In the future, freezing point depressions and specific gravities on urine collected only during peak excretion will be used to verify this osmolarity in patients receiving the various amounts of contrast agent.

It appears from all the available evidence that the actual maximum molecular concentration of the various contrast media will be about the same, at least for a short period of time, and for a longer period if the larger amounts are injected. The greatest urine concentration of the different iodides is a 0.22 molar solution. Urokon 10 per cent has a specific gravity of 1:067; therefore, the highest urine value obtained over a forty-five-minute collection, 1:076, would represent an 11 per cent solution if all the solutes were Urokon. According to Rapoport's tables on hydropenic osmotic diuresis, other substances such as urea, chloride, phosphate, etc., represent about 0.5 to 1.0 per cent of this weight value. The actual concentration of Urokon, then, is 10 to 10.5 per cent (0.18 molar solution). The molecular load of 25 c.c. of Urokon 70 per cent is 68 per cent of that with 60 c.c. of the mixture, since each Urokon molecule is 38.8 per cent heavier than the Diodrast and 17.8 per cent heavier than the Neo-Iopax molecule. Peak levels are obtained during the diuresis, since the drugs are not given in a constant drip and the smaller load of Urokon will produce a sharper peak. Therefore, specific gravity measured at the highest level (instead of over forty-five to sixty minutes) would probably have reached 1:080. However, a 1:090 value is necessary to correspond with a 12.7 per cent level (0.22 molar solution or 85 mg. iodine per c.c.) measured by Nesbit (9).

By interpolation, it can be deduced from the specific gravity that the mixtures produced a 9 to 10 per cent urine concentration (0.19 to 0.22 molar solution). Keates, with iodine determinations on ureteral specimens, found a high of 9 to 10 per cent urine concentration with Diodrast. Thus, in this series the molecular concentration of the mixtures is slightly greater than with Urokon. The specific gravity is lower because of the decreased molecular weight and because Diodrast displaces more water than equal weights of the other contrast media (10 per cent Diodrast, spe-

cific gravity 1:053; 10 per cent Neo-Iopax, specific gravity 1:070). It will be of value to measure actual iodine concentration and specific gravity at the peak levels. The specific gravity is a simple yet accurate determination of organic iodide concentration in hydropenic osmotic diuresis. Complete determinations on all ions and molecules in the post-pyelography urine would verify Rapoport's work. It is doubtful that pitressin (ADH) could have any further effect on the osmolarity (19).

One other important physical factor was present which plays an important part in limiting the urine concentration. After standing a short time, three to ten minutes, a marked precipitation of crystals occurs from the post-pyelography urine of dehydrated patients with good renal function when 70 per cent Urokon or 40 to 60 c.c. of the mixtures are used. This indicates that the urine must be a supersaturated solution of iodides. Alkalinizing the urine with sodium bicarbonate or heating will dissolve these various crystals. The *p*H of the urine decreases after injection of the mixtures and Urokon, probably due to an increase in excretion of dihydrogen phosphate, as occurs with P.A.H. (13). Hexagonal crystals of Neo-Iopax are the first to precipitate. Evaporating a drop of urine reveals more sheaf-like crystals of Diodrast than crystals of Neo-Iopax. The large amounts of contrast substances in the urine can be seen grossly and microscopically after evaporation.

There is no question that the maximum tubular excretion is exceeded even with the smaller amounts of iodides, since these smaller amounts (30 c.c. Diodrast) were used by Goldring and Chasis (5) as priming doses in their determination of Tm_D. Some clinicians (9) have explained the higher x-ray density with the larger doses on the basis of increased glomerular filtration, intimating production of increased, unlimited urine concentration. However, plasma levels and consequently the amount filtered would be increased only moderately and proportionately with the present amounts used, except for a few seconds during aortography and in animal experiments with extraordinary doses (11). Even when the amount filtered becomes great, urine concentration will not increase because of the diuresis. I believe that, with the present method of determining secretory Tm (only 500 c.c. of water are given orally just before the procedure), the value may be limited by the high tubular urine concentration of the drug. If a water diuresis were first utilized, Tm might increase in adults with normal renal function. This reasoning may explain the confusion about the fact that Tm decreases with high plasma levels in certain animals (1, 4, 16) because the high tubular concentration from filtration limits tubular excretion. Also, in these tests other substances were given concurrently and competed for the total osmolarity.

It is to be emphasized that the maximum drug concentrations in this study of urograms were obtained in young individuals who would concentrate to above 1:030. Renal function decreases considerably with old age (16). In patients not dehydrated, with poor renal function or with hydronephrosis, larger amounts of drugs will produce a greater x-ray density and an increase in urine iodide concentration, but never to a maximum value. In these circumstances, osmotic diuresis would not be a limiting factor. In the future, for the manufacture of better contrast media, larger molecules excreted by glomerular filtration and containing more atoms of iodine will have to be developed.

TECHNIC FOR UROGRAPHY

Despite the high-concentration agents and increased amounts of mixed contrast substances, it is necessary to use careful preparation and compression technic to produce urograms of excellent quality. Alimentary intake should be restricted for sixteen to eighteen hours, as was done in these series. It has been shown that urine specific gravity approaches a high level only after that length of time. A 50 per cent increase in concentration of excreted drug occurs after eighteen hours of dehy-

dration as compared to seven hours (7).

Compression is the most important tool available. With the patient in the Trendelenburg position, a three-minute film is first taken and read wet in order to change the timing of compression, if necessary, and to evaluate an existing hydronephrosis more accurately. It is best to apply compression in about seven to ten minutes after injection, since iodine concentration is greatest during that period. It is applied gently and slowly to a maximum over one to two minutes, so that voluntary abdominal muscle resistance will not develop. The band should be constantly tightened during the next two-minute period, since it gradually loosens with respiratory movements. If the pressure is properly utilized, only two minutes are necessary to fill the calyces and pelves. The ureters are readily blocked at the pelvic brim, with a remarkably rapid dilatation of ureters, pelves, and calyces taking place. In women the right side is usually the more dilated, probably as a result of increased right kidney distensibility due to previous pregnancies. The compression hydronephrosis also demonstrates that pressure alone is enough to cause the hydronephrosis of pregnancy, without postulating the hormonal influence.

The use of routine compression takes patience, time, and considerable effort, but the results justify the extra work. Another important point is the use of a large balsam block, 10.5 cm. thick, to transmit the pressure from the band directly to the lower abdomen. This latter point, of course, does not apply if inflation bags are used. A film taken immediately after removal of the balsam block shows excellent filling of the lower ureters. Rushed for time, the average x-ray technician attempts to apply the compression too rapidly and does not stay with the patient to keep the pressure at a high point; therefore, this valuable procedure often falls into disrepute.

Although cathartics are valuable, none were used in this series, but occasionally a sodium phosphate and biphosphate enema proved of great benefit in clearing the colon. Reading each film as the examination progresses, and taking oblique, lateral, and post-voiding films as indicated, aid in increasing the value of intravenous pyelography and eliminate unnecessary retrograde pyelograms. Late bladder films are helpful but, with 70 per cent Urokon and the larger quantities of the mixture, the shadow is so dense that filling defects would be obscured. To circumvent this result, it is necessary that the patient refrain from voiding for three to four hours before the examination. Low-voltage technic in thin patients to increase contrast occasionally has been invaluable in outlining the kidneys or masses and, in general, films on the dark side (high-density) aid in the interpretation of the urinary tract.

SUMMARY

Mixtures of Neo-Iopax and Diodrast proved to be a safe routine agent for intravenous pyelography-producing fewer side-reactions than either drug alone and affording an increase in film density in 30 c.c. amounts. Even 50 to 60 c.c. were well tolerated and increased x-ray contrast. With all contrast substances and with the mixtures, secretory Tm is exceeded (for only a short period with small amounts), but the actual urine molecular concentration is limited to about a 0.2 molar solution by an osmotic diuresis and by a supersaturation of iodides in the urine. Roentgen density improved with larger amounts (50 to 60 c.c.) because of an increase in diuresis, even though urine iodide concentrations did not increase significantly as demonstrated by specific gravity determinations. Urokon 70 per cent, although having minor disadvantages of temporary true and false proteinuria, arm pain and antecubital thrombophlebitis, produced a somewhat greater x-ray density because it contains more iodine to each molecule than the other agents. The only means of improving the urographic drugs is to increase the number of iodine atoms per molecule and to use large sized molecules, like inulin, excreted by glomerular filtration.

It is emphasized in this paper that no matter what agent is used, dehydration over sixteen to eighteen hours is important and adequate compression is most essential for obtaining high quality films. In dilating and filling the calyces, compression need be applied only two minutes if performed properly. Compression hydronephrosis is greatest in the right kidney in women. The haphazard use of compression by many technicians has sometimes brought it into disrepute.

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SUMARIO

La Urografía Intravenosa con Mezclas de Agentes Radiopacos

Las mezclas de Neo-Iopax y Diodrasto resultaron ser un medio sistemático inocuo para la pielografía intravenosa, produciendo menos reacciones colaterales que una u otra droga por sí sola y proporcionando un aumento en la densidad de las películas a candidades de 30 c.c. Con todas las substancias de contraste y con las mezclas, se excede la cap. tub. secretoria máx. (mas por poco tiempo con cantidades pequeñas), pero la real concentración molecular de la orina se limita a una solución molar aproximadamente de 0.2 por una diuresis osmótica y por una hipersaturación de yoduros en la orina. La densidad roentgenológica mejoró con las cantidades mayores (50 a 60 c.c.), debido al aumento de la diuresis, aunque no aumentaron mayor cosa las concentraciones urinarias de yoduros, según revelaron las determinaciones del peso específico. El único medio de mejorar las drogas urográficas consiste en aumentar el número de átomos de yodo por molécula y usar moléculas de tamaño mayor, como la inulina, excretadas por la filtración glomerular.

La deshidratación durante dieciséis a dieciocho horas es importante, y la compresión adecuada esencialísima, para la obtención de radiografías de alta calidad.

A Radiolucent Pneumatic Compressor for Mucosal Studies[1]

ISADORE KATZ, M.D.

NUMEROUS compression devices for obtaining mucosal studies of the gastrointestinal tract have been described. Many of these are cumbersome, their application is difficult and time-consuming, and they are uncomfortable for the patient. Most of those in current use do not allow unrestricted fluoroscopy when they are in place. By modifying and adapting several commonly employed commercially available and home-made devices, based upon the original Chaoul pneumatic compression apparatus (1–3), a simple, inexpensive pneumatic compressor has been evolved. Its ease of application and its successful daily use over a period of more than two years prompt this report.

Basically the device consists of an ordinary inflatable rubber compression bladder mounted in a radiolucent triple-layered Masonite board which automatically centers the part to be radiographed. Weighing only 5 pounds, the device is easily placed in position on the radiographic table prior to commencement of fluoroscopy in the horizontal position (Fig. 1). It remains in position on the table continuously throughout the fluoroscopic and radiographic phases of the examination. Being entirely radiolucent, it does not interfere with fluoroscopy and thereby allows the examiner to identify readily all barium-

Fig. 1. The compression device with balloon inflated, in position for fluoroscopy on the radiographic table. The pneumatic compressor automatically centers the part to the center of the Potter-Bucky diaphragm.

[1] From the Department of Radiology, Veterans Administration Hospital, Brooklyn 9, N. Y. Sponsored by the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the author are a result of his own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

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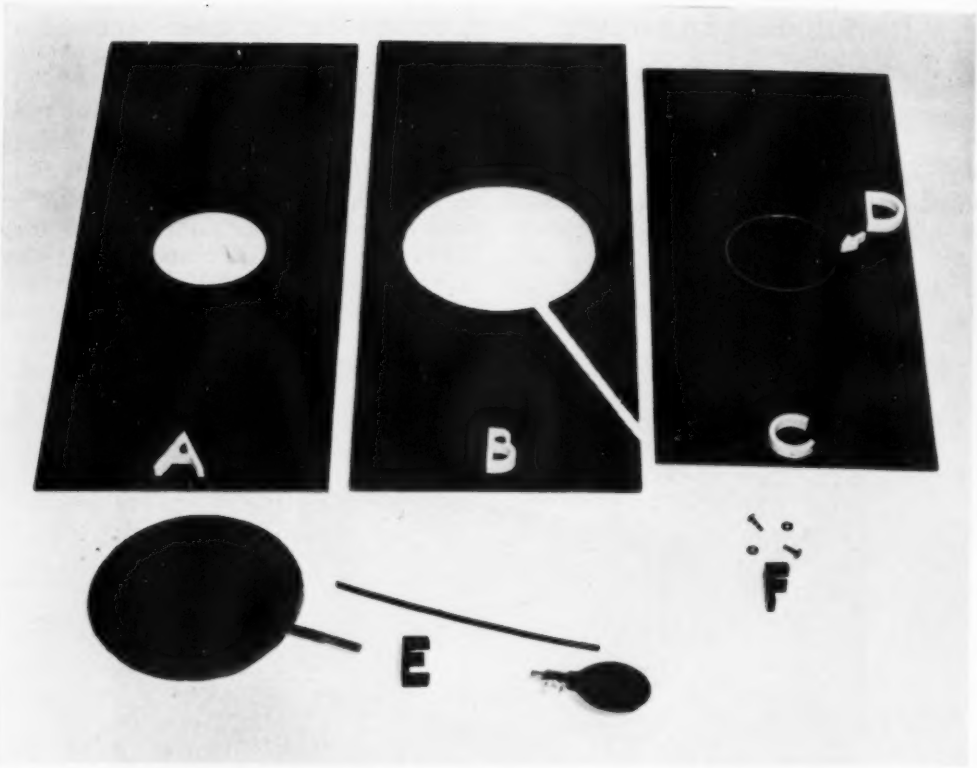

Fig. 2. Component parts of pneumatic compressor.
A. Top board of 1/8-inch Masonite; length equal to entire width of table top; width 11 inches; cutout 4 5/8 inches in diameter.
B. Center board of 1/4-inch Masonite; length and width same as board A; cutout 8 1/4 inches in diameter; diagonal channeled cutout 1/2 inch in width.
C. Bottom board of 1/8-inch Masonite; length approximately 2 1/2 inches less than boards A and B, so that it fits snugly between strips of metal trim bordering the x-ray table-top.
D. Radiopaque wire loop, 4 5/8 inches in diameter, imbedded below surface of board.
E. Parts of pneumatic portion of device: rubber balloon, 8 inches in diameter; plastic tubing; hand bulb and valve.
F. Aluminum rivets and washers (5/8 inch) used to hold three boards together.

filled portions of the gastrointestinal tract visible on the fluoroscopic screen. Thus a desired segment of the gastrointestinal tract may be selected promptly and centered for compression and radiographic examination. The device remains fixed in position and cannot be dislodged as the patient is moved about and positioned over it during the examination.

CONSTRUCTION OF APPARATUS

The apparatus can be constructed with ordinary woodworking tools in a few hours. Its component parts are illustrated in Figure 2, and are as follows:

1. The rectangular board, indicated in the figure by the letter A, represents the topmost of three Masonite boards which hold the inflatable rubber compression balloon in place. This top board is made of 1/8-inch Masonite; it is 11 inches wide, and its length is equal to that of the entire width of the x-ray table. The circular cutout measures 4 5/8 inches and is at the exact center of the long and short dimensions of the board. This is automatically the center of the x-ray table.

2. The middle board (B) is made of 1/4 inch Masonite and its length also equals the width of the x-ray table. Its

Fig. 3. The assembled compression device as it appears from its under surface to show the bolts at each end (arrows) which fit into screw holes in the metal trim bordering the top of the x-ray table. One screw on each side is permanently removed from the metal trim. These bolts hold the apparatus in fixed position as the patient is moved about over it.

width is 11 inches. The large circular cutout measures 8 1/4 inches and is centered to the center of the board. A half-inch channel is cut diagonally from the circular opening to the lower left hand border of this board, emerging at a distance of 3 inches from its left border.

3. The bottom board (C), made of 1/8 inch Masonite, is cut to fit snugly between the two metal trim strips that border the x-ray table on either side. Thus its long dimension will be approximately 2 1/2 inches less than that of the center and top boards.

4. A wire ring, made of ordinary steel, copper, or other radiopaque wire of 2/32- or 3/32-inch thickness is embedded in a shallow circular groove, 4 5/8 inches in diameter, which has been scored in the center of the upper surface of the bottom board (D) by a sharply pointed compass or similar tool. Embedded in this groove, the wire ring lies below the surface of the board.

5. The inflatable portion of this device is a rubber compression bladder (E), 8 inches in diameter, which can be procured from any x-ray supply firm. A suitable length of plastic tubing of rigid or semi-rigid construction is connected to the cock of the bladder. At the opposite end of the tubing is a hand bulb and valve such as are used in the ordinary sphygmomanometer. Flexible tubing may be used throughout if rigid plastic tubing is not available.

6. Rivets of aluminum and small washers (F) serve to hold the three boards together.[2] These are placed at the periphery of the apparatus and are illustrated as they appear in the under surface of the assembled device (Fig. 3).

ASSEMBLY OF APPARATUS

The three boards are temporarily clamped together in a vise and drill holes are made to receive the rivets. The component parts of the inflatable portion of the apparatus are then interconnected by means of suitable short lengths of rubber tubing.

[2] In place of rivets, special removable screws made of aluminum or heavier metals may be substituted. These are known as binding screws or "Chicago screws" and are used in binding loose-leaf ledger sheets. They may be purchased in any large stationery store.

The assembled bladder and hand bulb are laid upon the bottom board (Fig. 2C). The middle board (B) is laid upon board C so that the cutout portions surround the bladder-tubing. The top board (A) is placed upon board B, and the rivets are inserted and hammered to hold the three boards together. No gluing is necessary.

Fig. 4. Compression device in position under the patient, who is partially rotated off the inflated balloon for illustrative purposes. The Potter-Bucky tray and partially shielded 10 × 12-inch cassette (A) and lead-rubber cutout (B) are shown as aligned for polygraphic study. Each quadrant of the cassette is centered to the center of the board (arrow).

The upper and lower edges of the device are beveled and smoothed to reduce the thickness of the board at the points where the body of the patient rests upon it. The under surface of the rim of the circular cutout in board A should also be sanded and beveled to avoid contact of a sharp or rough margin with the bladder.

Ordinary steel bolts 1 1/4 inches long are placed at each end of the layered board to complete the apparatus (Fig. 3, arrows). When the device is placed in position on the x-ray table, these bolts drop into the screw holes in the metal trim which borders the table top, two of the original screws first having been removed from the table. These bolts serve to maintain the board in fixed position while the patient is moved about or positioned over it.

The assembled apparatus is only 1/2 inch in total thickness and causes little or no discomfort when it is in position under the patient. It is desirable, and may be possible, to construct this apparatus in such a manner as to reduce its thickness even further by employing thin sheets of Plexiglass or other suitable radiolucent materials in place of the Masonite. Several modifications of the present device are being developed, including one in which sponge rubber is used in place of one or more of the Masonite layers.

USE OF APPARATUS AND PROCEDURES FOR MAKING POLYGRAPHS

The following procedure for using this apparatus has been found most practical: When erect fluoroscopy of the esophagus and stomach has been completed, the device is slipped into position as the table is lowered for the horizontal examination (Fig. 1). This can be done without need

for the patient to step off the platform at the lower end of the radiographic table. Fluoroscopy in the horizontal position is performed with the apparatus in place and the part or region of which compression studies are desired centered within the metal ring (Fig. 2, D) which is visible fluoroscopically.

Under fluoroscopic control the rubber bladder is inflated to produce the desired degree of compression, and the overhead radiographic tube is placed in position (Fig. 4). Four separate exposures on a 10 × 12-inch film may be made with the conventional lead-rubber, shielded cassette in the Potter-Bucky tray (Fig. 4, B). The structure under compression by the inflated balloon is automatically centered to the center of the Potter-Bucky diaphragm. The quadrant of the polygraph film to be exposed (Fig. 4, A) is centered upon the center of the compression board (Fig. 4, arrow). In addition to polygraphic studies, single radiographic or fluoroscopic spot-film exposures of parts under compression may be made, *i.e.*, the ileocecal area as visualized during a barium-enema examination or any other compressible segment of the small or large intestine. The device has been found especially effective in compression study of the gastroenterostomy area following subtotal resection of the stomach, a region which is usually partially subcostal and difficult to compress with ordinary devices. When a given radiographic procedure has been completed, fluoroscopy can be resumed without disturbing the patient and additional segments of the gastrointestinal tract may be brought into position for compression and radiographic study, as desired. In the course of small intestinal studies the device serves as an effective palpator during the fluoroscopic phases of the examination. This reduces to a large extent the need for manual palpation.

SUMMARY

1. A radiolucent pneumatic compressor of simple design and construction for mucosal studies of the gastrointestinal tract is described.

2. Its practicality and simplicity of application, with relative lack of discomfort to the patient, have been demonstrated in continuous daily use for over a two-year period.

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SUMARIO

Compresor Neumático Radioluciente para Estudios de las Mucosas

Descríbese un sencillo aparato neumático de compresión para llevar a cabo estudios de la mucosa del tubo gastrointestinal. Trátase de una modificación de varios aparatos de empleo corriente, basados en el primitivo compresor de Chaoul. Consiste en realidad en una ordinaria vejiga compresora inflable de caucho, montada en un tablero radioluciente de tres capas de Masonita, que centra automáticamente la parte que va a radiografiarse. Puede colocarse en la mesa del aparato de rayos X antes de la roentgenoscopia en posición horizontal, dejándose allí durante todo el estudio fluoroscópico y roentgenográfico. Suministra estudios poligráficos así como exposiciones instantáneas radio- o fluorográficas aisladas.

El uso diario del aparato durante un período de dos años ha demostrado su valor práctico y sencillez y la relativa falta de molestia para el enfermo.

New Twelve by Twelve-Inch Roll Film Magazine for Rapid Serial Roentgenography[1]

ISRAEL STEINBERG, M.D., WILLIAM DUBILIER, M.D., and JOHN A. EVANS, M.D.

IN 1949, A ROLL FILM magazine for angiocardiography and cerebral angiography was described (1). This device, a modification of the Fairchild aerial photography camera, brought about a great advance in serial radiography, but because of the relatively small size of the individual

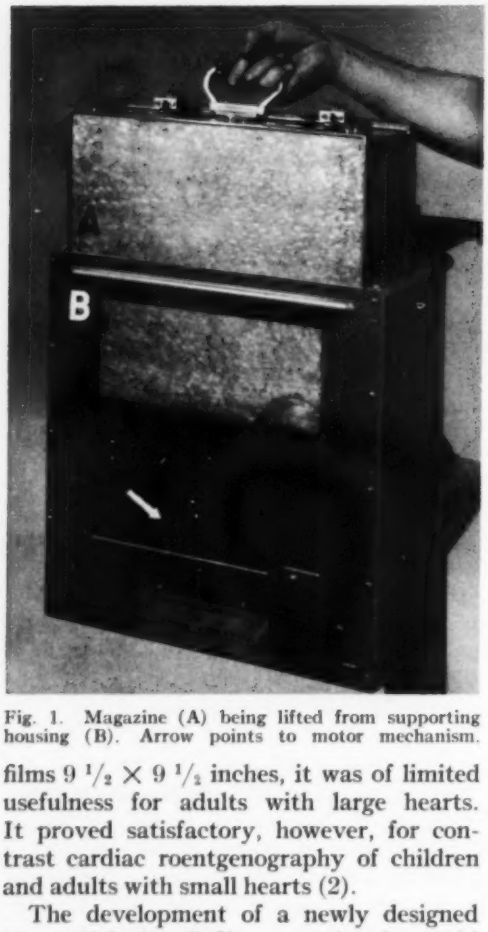

Fig. 1. Magazine (A) being lifted from supporting housing (B). Arrow points to motor mechanism.

films 9 $^1/_2$ × 9 $^1/_2$ inches, it was of limited usefulness for adults with large hearts. It proved satisfactory, however, for contrast cardiac roentgenography of children and adults with small hearts (2).

The development of a newly designed 12 × 12-inch roll film magazine for rapid serial roentgenography has made possible

Fig. 2. Magazine in horizontal position. A. Hinged swinging door, permitting easy removal of "camera." B. Device for marking film sequence. Arrow points to film counting mechanism.

the contrast roentgen examination of enlarged hearts, most of the pulmonary circulation, the abdominal aorta, the splenoportal system, and other examinations for which a larger film area is required.

DESCRIPTION OF THE MAGAZINE

The magazine consists of two main parts: (*a*) a removable light-proof box which contains the roll film, screens, and grid, and (*b*) a metal frame housing which supports the magazine and contains the motor mechanism which transports the film. Roll film measuring 12 inches or less may be used in this device. This makes for economy if 9 $^1/_2$-inch film is required for serial roentgenography of children or

[1] From the Department of Radiology, The New York Hospital-Cornell Medical Center, New York, N. Y. Accepted for publication in July 1954.

cerebral angiography. A high-ratio grid (8 to 1) and fast radiographic screens are employed to afford minimal radiation scatter and rapid exposure.

Figure 1 shows the magazine (A) fitting into the housing (B). The arrow points to the motor mechanism ($^1/_6$ horse power). The magazine ready for use in the vertical plane is shown in Figure 2. The hinged

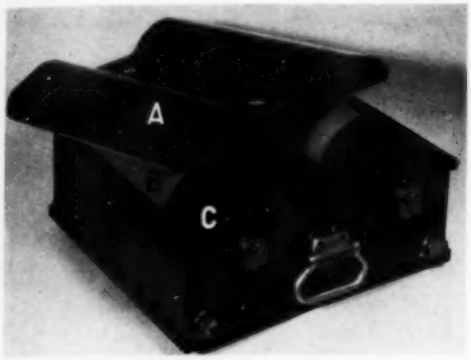

Fig. 3. Magazine being opened. Cover (A) is raised, disclosing spools of $9^1/_2$-inch roll film (B), kept in place by an adapter (C).

swinging door (A) provides stability when shut, and permits easy withdrawal of the magazine when opened. At the lower right corner (B), a device with a disk containing lead numbers marks the film sequence on the exposed film. The arrow at the lowest corner points to an automatic mechanism for counting the transported film strips. Figure 3 shows the magazine with cover raised (A). Underneath may be seen spools of $9^1/_2$-inch film (B), kept in place by a special adapter mechanism (C). Figure 4 demonstrates the opened magazine. It shows 12-inch film (A) threaded between fluorescent screens (at the under surface of the magazine) and its attachment to the take-up spool (B).

The magazine is made of aluminum alloy and weighs only 35 pounds when fully loaded and so is transportable. Film loading is simple and takes but a few minutes. If a freely movable hydraulic stand is used to mount the roll film magazine unit, raising and lowering for proper positioning will be easily accomplished. A hinge at-

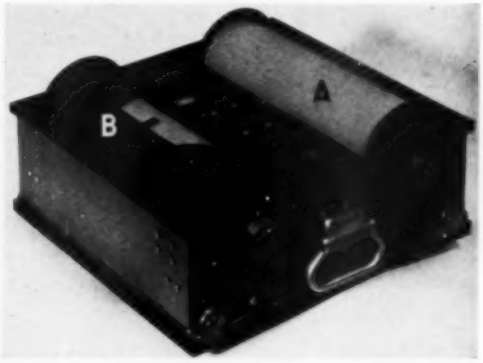

Fig. 4. Magazine opened. Twelve-inch film (A) is threaded between screens (on the under surface). The film is fixed to the "take-up spool" (B) with adhesive.

tached to the back of the device will permit its use in the horizontal plane. Another feature is the adapter for roll film of $9^1/_2$-inch size.

A special electronic timer utilizing high milliamperage and kilovoltage has been employed. This permits serial exposures as fast as $^1/_{60}$ second with high kilovoltage at a target film distance of 48 inches. The present model has an exposure rate of two films per second. The 12-inch roll film has an overall length of 75 feet. This allows approximately 70 films for each roll.

COMMENT

The advantage of a large film area for angiocardiography is obvious. Positioning of patients is simplified and the visualization of even large hearts (Figs. 5A and B; 6A, B and D) becomes possible. The magazine has also been used successfully for percutaneous splenoportal venography (Fig. 5C) (3), abdominal aortography (Fig. 5D), and serial esophography.

The magazine may also be employed for *routine single exposure radiographs* where a 12-inch square film size is adequate. This eliminates the use of cassettes and saves time in film processing. Instead of individual film processing, the entire exposed roll can be developed at the end of each day's work. The individual films can then be cut, read, and stored in the usual manner.

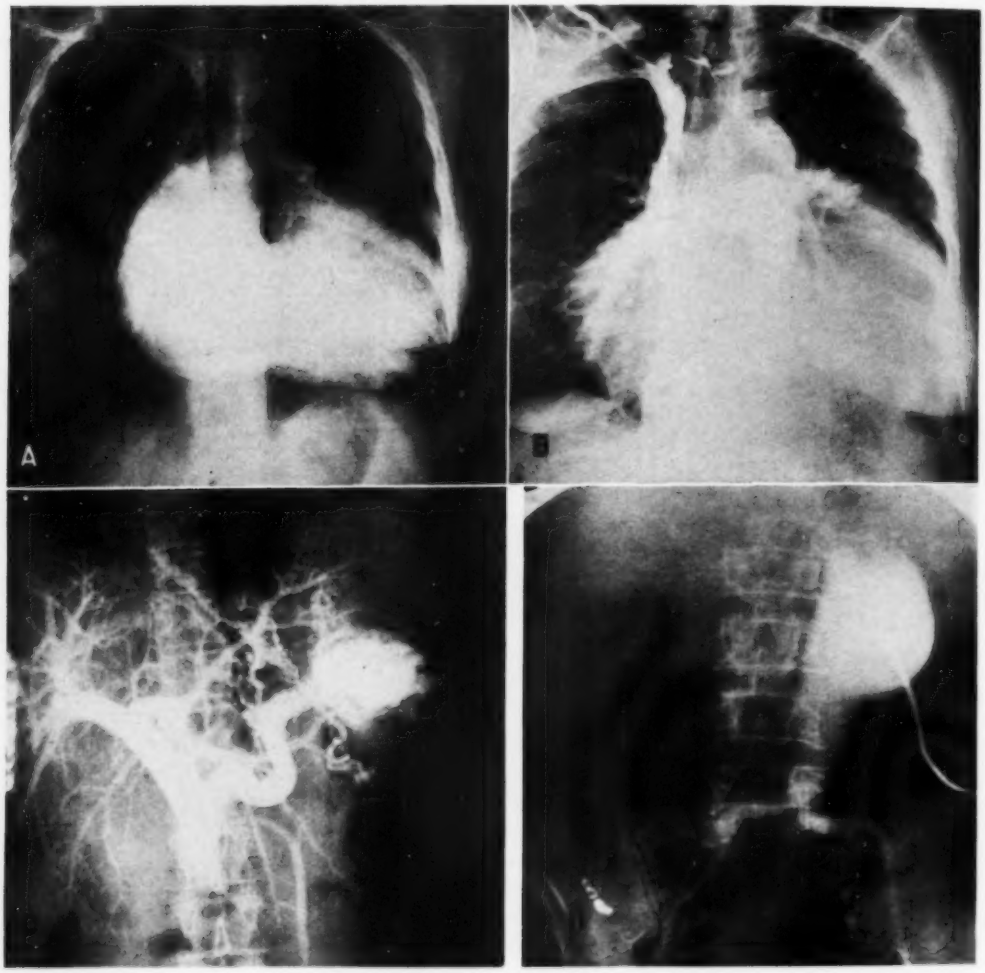

Fig. 5. Rapid serial roentgenography utilizing 12 × 12-inch roll film.
A. Angiocardiogram of an adult with Ebstein's anomaly of the tricuspid valve.
B. Angiocardiogram demonstrating massive pericardial effusion in a 53-year-old woman.
C. Splenoportal venography (percutaneous puncture of the spleen).
D. Abdominal aortography (Dos Santos technic), showing an arteriosclerotic abdominal aortic aneurysm.

Recently, a mechanical automatic dryer has simplified the drying process of roll film (4)

The pilot model of the new 12 × 12-inch roll film magazine has been in constant use for over a year and has been singularly free of mechanical failure. New screens have occasionally been necessary. The roentgenograms have been of excellent quality. Screen contact is good, and static marks have been rare. So far, an exposure rate of only two films per second has been possible. The limited speed of the magazine has been its only disadvantage, for in cyanotic congenital cardiac disease, in which right-to-left shunt usually exists, multiple films per second are desirable. Efforts are being made to increase the number of films per second.

SUMMARY

A new, commercially available, 12 × 12-

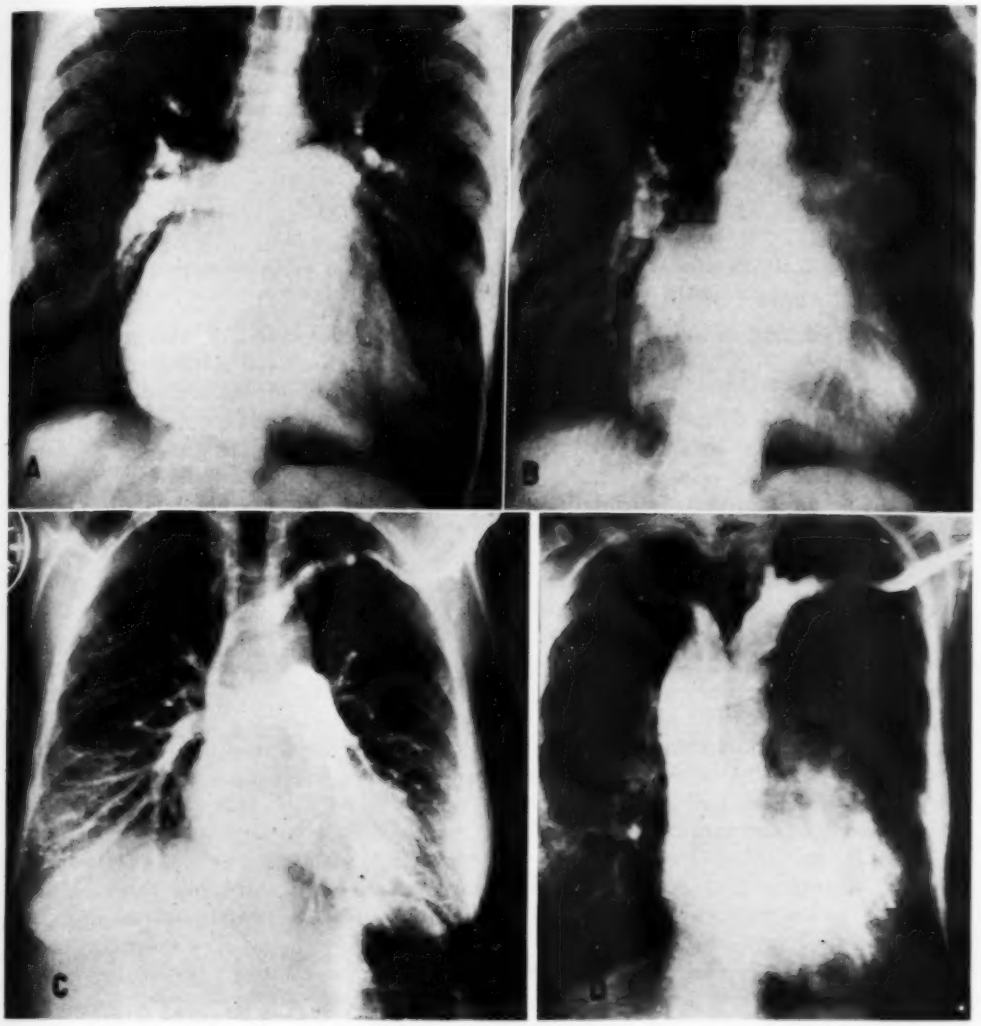

Fig. 6. Value of large film for angiocardiography. A. Rheumatic heart disease. Angiocardiography at five seconds, with large right atrial dilatation (tricuspid regurgitation), right ventricular and pulmonary arterial enlargement.

B. Same patient, at 25 seconds, showing an enlarged left atrium (mitral stenosis).

C. Normal pulmonary arterial circulation of an adult (38 years) of small stature.

D. Nine by twelve-inch angiocardiogram of a patient with total anomalous pulmonary venous drainage into the left innominate vein via a persistent left superior vena cava.

inch automatic roll film magazine singularly free of mechanical failure has had over a years trial. Contrast roentgenography of enlarged hearts and splenoportal venography has become practical. A speed of two films per second limits the study of patients with cyanotic congenital heart disease. In *all* other types of heart disease, both congenital and acquired, satisfactory films of excellent quality have been obtained.

NOTE: Bernard K. Ryan, x-ray technician, Department of Radiology, New York Hospital, provided invaluable technical assistance.

The roll film magazine is manufactured by the F. and R. Machine Works, Woodside, N. Y.

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SUMARIO

Nueva Cámara para Rollos de Película de Treinta por Treinta Centímetros para al Roentgenografía Rápida en Serie

Una nueva cámara automática para rollos de película de 30 × 30 cm., ya puesta a la venta y notablemente exenta de defectos mecánicos, lleva más de un año de prueba. La roentgenografía de contraste de los corazones hipertrofiados y la venografía esplenoporta se han convertido así en factibles. Una velocidad de dos radiografías por segundo limita el estudio de los enfermos que tienen cardiopatía congénita cianótica. En todas las demás formas de afección cardíaca, tanto congénita como adquirida, se han obtenido radiografías satisfactorias de excelente calidad.

EDITORIAL

The Physiological Point of View

Radiology may be proud of its leadership in investigations into normal and abnormal physiology. The recent brilliant studies of the swallowing function in man, by Ramsey *et al.* (7), are a classical example of the application of the roentgen method to the demonstration of the intricacies of fundamental physiological mechanisms heretofore known only in broad outline. Under such a stimulus, we may well pause to consider the physiological point of view.

Since it has become an axiom in medical diagnosis that pathological physiology may precede by months or even years the development of anatomical changes in a diseased organ, the more general application of this principle in radiological diagnosis would contribute greatly to preventive medicine and increase the cure rate in many diseases, especially cancer. There may be some radiologists, however, who overlook the opportunities for study of normal and abnormal function in their daily practice of medicine. Of these I beg earnest attention.

Many of the organ systems in the body lend themselves to physiological investigation by everyday radiologic technics available to all of us. In the Carman lecture of 1942, a brilliant essay which merits careful study today, Pendergrass (3) reviewed the aspects of renal physiology suitable for roentgen study. It is doubtful whether this knowledge is utilized by many radiologists in their daily practice.

Between the years 1936 and 1952, interest in radiology of the small intestine on the part of several investigators (4, 5, 6) contributed fundamental information concerning its radiological appearance in health and disease which should form part of the background of everyone concerned with gastrointestinal diagnosis. This includes changes in pattern and motility after ingestion of various foods, the appearance in deficiency states, and the reflection of some endocrinopathies, notably thyroid dysfunction. Clinical application of this knowledge would pay dividends in many obscure medical problems.

With the development of modern thoracic surgery, an impetus has been given to the study of pulmonary physiology which has added a fascinating chapter to medical knowledge. Laboratory studies of pulmonary function, as outlined by Comroe *et al.* (2), contribute to the understanding of many diseases and the preoperative evaluation of the patient. Experience has shown that radiological procedures are useful in detecting qualitative changes in pulmonary function and yield approximate quantitative information in some instances (1). Qualitative evaluation of lung volume, ventilation, and pulmonary distribution of inspired air may often be obtained by the roentgen examination of the chest. Since this examination is almost universally available in this country, and special laboratories for quantitative tests of pulmonary function are few, it is evident that the contribution of the alert radiologist in this field may be of considerable importance to the patient.

Finally, diagnostic information concerning abnormalities in the circulation of the blood stems almost entirely from opacification technics. Furthermore, it is now accepted as a commonplace that anatomical organic changes in organs and tissues may be studied indirectly by the altered circulation associated with them. Significant information about intracranial, pulmonary, and renal tumors may be ob-

tained by arteriography and venography.

These are but a few of the examples of the application of radiology to the study of physiology in health and disease. No attempt has been made to include here special technics, such as the use of radioactive substances in physiological investigations, and in localization of disease. No mention has been made of the challenge of the pancreas or the colon to physiological investigation by roentgen methods. Enough has been said, however, to support the original premise that more radiologists should become interested in function as distinguished from the gross anatomy of disease in its well-developed or advanced stage.

Let us strain at the gnat and forget the camel.

ROBERT P. BARDEN, M.D.

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ANNOUNCEMENTS AND BOOK REVIEWS

ARIZONA RADIOLOGICAL SOCIETY

The following officers have been elected to head the Arizona Radiological Society for the ensuing year, President, Dr. R. Lee Foster, Phoenix; Vice-President, Dr. John Wilson, Tucson; Secretary-Treasurer, Dr. James J. Riordan, 550 W. Thomas Rd., Phoenix.

BALTIMORE CITY MEDICAL SOCIETY RADIOLOGIC SECTION

At a recent meeting of the Radiologic Section of the Baltimore City Medical Society, the following officers were elected for the coming year: Chairman, Walter L. Kilby, M.D.; Secretary-Treasurer, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17.

CONNECTICUT STATE MEDICAL SOCIETY SECTION ON RADIOLOGY

At the annual meeting of the Section on Radiology of the Connecticut State Medical Society, June 9, Dr. William G. H. Dobbs of Torrington was elected President, and Dr. John Burbank of the Meriden Hospital, Meriden, Secretary-Treasurer.

RADIOLOGICAL SOCIETY OF LOUISIANA

At the recent annual meeting of the Radiological Society of Louisiana, the following officers were elected: President, G. M. Riley, M.D., Shreveport; Vice-President, Manuel Garcia, M.D., New Orleans; Secretary-Treasurer, W. S. Neal, M.D. 602 Pere Marquette Bldg., New Orleans.

NEW ENGLAND ROENTGEN RAY SOCIETY

At the annual meeting of the New England Roentgen Ray Society, the following officers were elected for the year 1955–56: President, Max Ritvo, M.D., Boston; Vice-President, A. B. Soule, Jr., M.D., Burlington, Vt.; Treasurer, Magnus I. Smedal, M.D., Boston; Secretary, Raymond A. Dillon, M.D., 24 Wedgemere Ave., Winchester, Mass.

PITTSBURGH ROENTGEN SOCIETY

At the meeting of the Pittsburgh Roentgen Society, held June 8, 1955, the following officers were elected: Dr. Joseph E. Malia, President; Dr. Erwin Beck, Vice-President; Dr. Norman Tannehill, Secretary; Dr. Harrison Richardson, Treasurer; Dr. Leslie Osmond, Member of the Executive Committee; Dr. Samuel G. Henderson, Councilor to the American College of Radiology; Dr. Joseph T. Danzer, Alternate Councilor.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA

At the May 1955 meeting of the Radiological Society of Southern California, the following officers were elected: Chairman, Lowell S. Goin, M.D., Los Angeles; Vice-Chairman, John D. Camp, M.D., Los Angeles; Secretary-Treasurer, James B. Irwin, M.D., 1831 Fourth Ave., San Diego. Other members of the Board of Directors are: Donald R. Laing, M.D., Pasadena, and George Jacobson, M.D., Los Angeles.

SOUTH CAROLINA RADIOLOGICAL SOCIETY

At the regular spring meeting of the South Carolina Radiological Society, George Smith, M.D., was elected President; Willis Hood, M.D., Vice-President; Samuel W. Lippincott, M.D., 103 Rutledge Ave., Charleston, Secretary-Treasurer.

TENNESSEE RADIOLOGICAL SOCIETY

The newly elected officers of the Tennessee Radiological Society are: President, Dr. John M. Wilson, Memphis; Vice-President, Dr. Ben R. Mayes, Nashville; Secretary-Treasurer, Dr. George K. Henshall, 311 Medical Arts Building, Chattanooga 3.

UPPER PENINSULA RADIOLOGICAL SOCIETY

At the recent meeting of the Upper Peninsula Medical Society (Michigan), a new group was formed, consisting of the radiologists of the Upper Peninsula. The group will be known as the Upper Peninsula Radiological Society. The following officers were elected: Dr. L. Grant Glickman, Menominee, President; Dr. T. Boyd Bolitho, Marquette, Vice-President; Dr. Arthur Gonty, Menominee, Secretary. The group will meet quarterly.

SOCIEDAD DE RADIOLOGÍA CANCEROLOGÍA Y FÍSICA MEDICA DEL URUGUAY

The Society of Radiology, Cancer Research, and Physical Medicine of Uruguay announces the election of the following officers: President, Dr. Héctor Bazzano; Vice-President, Dr. Luis A. Vasquez Piera; Secretary-General, Dr. Roberto Francois; Recording Secretary, Dr. Ricardo Parada; Treasurer, Dr. Enrique Capandegui; Vocals, Dr. Nicolas Caubarrere and Dr. Olga Barcia de Kasdorf.

SOCIEDAD VENEZOLANA DE RADIOLOGÍA

The newly elected officers of the Venezuelan Radiological Society are: Dr. Otto Paz, President;

Dr. Joel Valencia Parparcen, Vice-President; Dr. H. Landaeta Payares, Apartado de Correos No. 1733, Caracas, Corresponding Secretary; Dr. Luis E. Gámez, Recording Secretary; Dr. H. Tosta Pérez, Treasurer; Dr. Francisco Banchs, Vocal.

EASTERN CONFERENCE OF RADIOLOGISTS

The Eastern Conference of Radiologists will meet in Baltimore, March 15–17, 1956, at the Lord Baltimore Hotel. This informal organization has been meeting annually since before 1915, the New England Roentgen Ray Society, the Radiological Section of the Baltimore City Medical Society, the New York Roentgen Ray Society, the Philadelphia Roentgen Ray Society, and the Radiological Section of the District of Columbia Medical Society acting in rotation as hosts. There is no formal membership and the host society plans its own program each year. Advance registration for the 1956 sessions may be made by writing Richard B. Hanchett, M.D., 705 Medical Arts Building, Baltimore 1.

RESIDENCY TRAINING IN RADIOLOGY AN ANNOUNCEMENT

In collaboration with the Joint Residency Review Committee for Radiology, representing the American Board of Radiology and the Council on Medical Education and Hospitals of the American Medical Association, the American Board of Radiology has adopted the following policy:

"Effective immediately, hospitals and institutions making initial application for approval for residency training in radiology must qualify for full three-year approval. No new residencies of one or two years duration will be approved unless they are integrated with or contributory to a fully approved program.

"It is strongly recommended that all hospitals and institutions presently approved for residency training in radiology develop programs offering complete training, either intramurally or through affiliation by June 30, 1957."

Residents who have accepted appointment to programs which are presently approved for less than three years will receive full credit for their training on the basis of the residency's present status, through June 30, 1957.

GRANTS-IN-AID FOR RADIOISOTOPE TRAINING

Realizing the need for increased training and educational opportunities in the radioisotope field, Abbott Laboratories has set aside the sum of $2,000, from which grants-in-aid will be made to suitable training courses or programs offered by recognized educational institutions and hospitals.

Instruction must be of such a nature as to provide in the course, or as an adjunct thereto, the basic information and clinical experience required by the Atomic Energy Commission for the use of at least one isotope.

Individual grants may be expended for the improvement of laboratory facilities, for the procurement of guest speakers, or in any other way the directors of the training programs may elect.

In Memoriam

FRANCIS B. WILLIAMS, M.D.

Francis B. Williams, a pioneer radiologist[1] of San Francisco, was born in Iowa and traveled with his family by covered wagon to Indian Territory (now Oklahoma) at the age of two. On this journey two of the children and the mother were drowned, Francis being rescued only because his mother held him high over her head. His father was an Indian Agent and Francis would tell his own children about how he had sat in the lap of the Chief of the Arapahoes, how he had ridden 8 miles to school, and how the herds of buffalo roamed the plains.[2]

He was educated at the College of the Pacific (at that time in San Jose) and the College of Physicians and Surgeons (now a dental college), receiving his M.D. in 1900. Next year he interned at San Francisco Hospital. In 1903 he married Eleanor Harlow Stephens, who died in 1945. Of their four children, two survive.

Dr. Williams took graduate work at Stanford, where he must have studied under the late Walter Boardman. He entered the field of radiology in 1916, but always gave a quarter to half his time to general practice. About 1920 he moved his office to downtown San Francisco, and continued there until the Navy took over the building during World War II and dispossessed the tenants.

As with many a pioneer, Dr. Williams' x-ray protection was inadequate and he had to have a foot amputated for cancer developing in a roentgen dermatitis. He was enthusiastic for roentgen therapy for dermatologic conditions and in the 1920's published several essays on its use in benign conditions. His eldest son died of carcinoma that developed in the scars of acne treated with x-rays some twenty years before.

Dr. Williams was a member of his county and state medical societies, the American Medical Association, and the Radiological Society of North America. He was certified in radiology in 1938 and was a member of the American College of Radiology. He was devoted to his patients and in later years his friendly countenance was less often seen at county medical society meetings.

[1] Not to be confused with that earlier pioneer of radiology, Francis H. Williams.

[2] These notes of Dr. Williams' early life were kindly supplied by his daughter, Mrs. Eleanor Walker.

He died Jan. 11, 1955, in Los Altos, California, after a prostatic operation. He had reached the ripe age of eighty-three. R. R. NEWELL, M.D.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE SPINE. A RADIOLOGICAL TEXT AND ATLAS. By BERNARD S. EPSTEIN, M.D., Chief, Department of Radiology, The Long Island Jewish Hospital, New Hyde Park, N. Y. A volume of 540 pages, with 721 illustrations. Published by Lea & Febiger, Philadelphia, 1955. Price $16.50.

RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. Brit. J. Radiol. Supplement 6. A volume of 92 pages, with numerous graphs and tables. Published by the British Institute of Radiology, London, 1955. Price 10*s.* 6*d.* (paper-bound), 12*s.* 6*d.* (cloth); to members of the British Institute of Radiology, 7*s.* 6*d.* and 9*s.* 6*d.*

ERLÄUTERUNGEN ZU DEN STRAHLENSCHUTZNORMEN FÜR MEDIZINISCHE RÖNTGENEINRICHTUNGEN, -ANLAGEN UND RÖNTGENSCHUTZKLEIDUNG. DIN 6811, 6812, und 6813. Im Auftrage des Fachnormenausschusses Radiologie im Deutschen Normenausschuss in Arbeitsgemeinschaft mit der Deutschen Röntgengesellschaft. By H. GRAF and A. SCHAAL, Erlangen. A paper-bound volume of 90 pages, with 10 illustrations. Published by Georg Thieme Verlag, Stuttgart. Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York, N. Y., 1955. Price DM 8.70.

Book Reviews

HYPEROSTOSIS CRANII. STEWART - MOREL SYNDROME; METABOLIC CRANIOPATHY; MORGAGNI'S SYNDROME; STEWART-MOREL-MOORE SYNDROME (RITVO); LE SYNDROME DE MORGAGNI-MOREL. By SHERWOOD MOORE, M.D., Professor Emeritus of Radiology, Washington University School of Medicine; Former Director of the Edward Mallinckrodt Institute of Radiology, St. Louis, Mo. A volume of 226 pages, with 107 illustrations and 7 tables. Published by Charles C Thomas, Springfield, Ill. Price $10.50.

Prof. Sherwood Moore has prepared an excellent monograph on a subject, hyperostosis cranii, which he has been studying for many years and to which he has made significant contributions. It is unfortunate that the etiology of this condition remains obscure.

Four types of hyperostosis make up the author's classification: hyperostosis frontalis interna, hyperostosis calvariae diffusa, nebula frontalis, and hyperostosis frontoparietalis. All phases of the condition are covered, including the roentgen diagnosis, the dimensions of the skull as determined roentgenologically, the clinical aspects, pathology, treatment, social and economic aspects, and even paleopathology. A statistical analysis of comparative measurements of normal and hyperostotic skulls is of special interest. An excellent historical review is appended, and there is a voluminous bibliography. This is a valuable and complete study which will be welcomed by radiologists and clinicians who are interested in further study of this condition and its possible etiology.

THE ABNORMAL PNEUMOENCEPHALOGRAM. By LEO M. DAVIDOFF, M.D., Professor and Chairman of the Department of Surgery of the Albert Einstein College of Medicine, and Director of Surgery, Bronx Municipal Hospital Center; Chief of Neurosurgery, Mount Sinai Hospital, New York, N. Y., and BERNARD S. EPSTEIN, M.D., Chief, Department of Radiology, The Long Island Jewish Hospital, New Hyde Park, N. Y. A volume of 518 pages, with 291 figures. Published by Lea & Febiger, Philadelphia. 2d ed., 1955. Price $15.00.

The first edition of Davidoff and Epstein's *The Abnormal Pneumoencephalogram* appeared in 1950. The second edition is similar in plan. After a brief discussion of the interpretation of plain films, there is a general consideration of pneumoencephalography and its technic. A chapter on pathology of brain tumors follows, after which come chapters considering individually the findings in neoplasms localized to the various lobes of the brain. Actual case histories as well as selected films from pneumoencephalographic examinations are included. "Non-neoplastic tumors" next engage the authors' attention, including chronic subdural hematoma, brain abscess, syphilis, vascular anomalies, cerebral hemorrhage and thrombosis. The last few chapters are concerned with non-tumorous lesions, as arachnoiditis, central nervous system infections, and atrophy.

The illustrations are good and in almost every instance the roentgenograms are reproduced as negatives. The book is excellent in case material, scope, and approach. It is recommended to radiologists, students of radiology, and to neurologists and neurosurgeons.

X-RAY ATLAS AND MANUAL OF ESOPHAGUS, STOMACH AND DUODENUM. By Dr. T. J. J. H. MEUWISSEN, Consulting Physician and Radiologist at Eindhoven (The Netherlands), with an Introduc-

tion by ROBERT D. MORETON, M.D., F.A.C.R., Radiologist at Fort Worth, Texas (U. S. A.). Edited by Dr. G. C. F. BRINKBOK, Radiologist at Amsterdam and translated by MAY HOLLANDER, Selborne (England). A volume of 688 pages, with 1,201 illustrations and 11 schematic drawings. Published by the Elsevier Press, Houston, Texas. Price $25.00.

This is an unusually complete atlas covering the upper gastrointestinal tract. It is directed especially to medical practitioners who wish to avail themselves of radiological data but will prove of interest also to the student of radiology and to the more experienced radiologist, whom it will serve for ready reference.

The work is divided into three main sections, devoted to (1) the pharynx and esophagus, (2) the stomach, and (3) the duodenum. A short additional chapter concerns the postoperative stomach. In each of these sections the author describes the anatomy, physiology, and pathology of the area under discussion. No attempt has been made to give a comprehensive description of the individual lesions. There are, however, a great number of case histories covering almost all of the common affections of the upper alimentary tract. Four hundred and seventy-nine case reports are illustrated with more than a thousand roentgenograms, excellently reproduced in the negative form. Many of these will be found to be of special value for teaching purposes.

APPLIED X-RAYS. By GEORGE L. CLARK, Ph.D., D.Sc., Research Professor of Analytical Chemistry, University of Illinois. A volume of 844 pages, with 415 figures and 23 tables. Published by McGraw-Hill Book Co., Inc., New York, Toronto, and London, 4th ed., 1955. Price $12.50.

This book covers an extremely wide field—the use of x-rays in medicine, industry, and research. No one man can be an authority in such widely differing specialties, and the sections which deal with Dr. Clark's own field, chemistry, are outstanding. Industrial researchers will find the book of special interest for the section on metals. Workers in the medical field will be interested only in Part I, which deals with x-ray physics and the biological effects of x-rays. This section, however, is not quite up to the standard of Part II, and some of the statements may be questioned. For example, in the chapter on biological effects of x-radiation the author makes the statement that "all sorts of procedure have been suggested for treating cancer other than surgery, x-rays, radium, or neutrons, but as yet no chemical (including snake venom), hormonal, biological, or dietetic method has proved of the least value in the control of this disease," and again on the same page: "Dietary control may be an important factor in inhibition of tumor induction and control."

FUNDAMENTALS OF RADIOBIOLOGY. By Z. M. BACQ, Professor in the University of Liège, Corresponding Member of the Royal Academy of Medicine of Belgium, and PETER ALEXANDER, Chester Beatty Research Institute, Institute of Cancer Research, Royal Cancer Hospital, London. A volume of 390 pages, with numerous illustrations, graphs and tables. Published by Academic Press Inc., N. Y. and Butterworths Scientific Publications, London, 1955. Price $6.50. Published in French as PRINCIPES DE RADIOBIOLOGIE, by Masson & Cie, Paris, 1955. Price 4,250 fr.

This survey of research in the field of radiobiology covers the work of physicists, chemists, biologists, and clinicians. Included are theories of the action of radiation on matter and experiments designed to test them, a discussion of the chemical and biological factors which alter the response to radiation, observations on the general effects of ionizing radiations on human beings, and the possible dangers to the population.

The book should stimulate research workers because it correlates the work of so many specialists, setting forth the trend of present studies and pointing out possibilities for future experiments. The extensive bibliographies at the end of each chapter should be of especial value to newcomers entering this field, and the warnings of pitfalls to be avoided in the design of experiments should be a help. Radiotherapists will be interested in the experiments which determine the mechanism of the action of the radiation whose results they observe. In this day of concern over danger to the race from nuclear energy, the radiologist is often called on for advice. He will find here in concise form the present status of knowledge on this subject.

AUTORADIOGRAPHY IN BIOLOGY AND MEDICINE. By GEORGE A. BOYD, Director, Arizona Research Laboratories, Phoenix, Ariz.; formerly, Professor of Biophysics, University of Tennessee, and Senior Scientist, Oak Ridge Institute of Nuclear Studies. A volume of 400 pages, with 98 illustrations and 27 tables. Published by Academic Press Inc., New York, N. Y., 1955. Price $8.80.

In writing his treatise on autoradiography as applied to biology and medicine, the author has had in mind the researcher who has never made use of this technic. The result is an extremely practical guide. Each step of the different procedures is described clearly and in detail, so that they can be carried out by workers with no previous experience. The material is well organized. Preceding the chapters on the actual technics is a section on theory, explaining the principles involved so that proper choice may be made of the method and materials appropriate for the problem. This section concludes with a chapter on sources of error, which should prove very useful.

The concluding section of the work is a bibliog-

raphy, cross-indexed in a manner similar to that used for punch cards, which should make it easy to find exactly the information desired. Drawings illustrate different steps in obtaining an autoradiogram and elucidate the directions. With this book for a springboard, the laboratory worker will be able to get a good start in the field of autoradiography.

OPERATIVE CHOLANGIOGRAPHIE. TECHNIK, DIAGNOSTIK, PRAXIS. By Priv.-Doz. Dr. WALTER HESS, Oberarzt der Chirurg. Univ.-Klinik Basel, with a Foreword by Prof. Dr. R. Nissen, Direktor der Chirurg. Univ.-Klinik Basel. A volume of 202 pages, with 150 illustrations. Published by Georg Thieme Verlag, Stuttgart. Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York, N.Y., 1955. Price DM 42.—($10.00).

It is the intention of the author to acquaint the German-speaking medical world, through this book, with the benefits of routine operative cholangiography. According to him, the United States, Germany, and Switzerland have been particularly slow in accepting this procedure. The reason for the delayed recognition of the method in these countries lies in faulty technic. The mere taking of radiographs is insufficient for an adequate diagnosis. It must be combined with manometric readings according to the method of Caroli or that of Mallet-Guy developed in France in 1941 and 1942.

Manometric readings thus form the main topic of the book, while roentgenographic interpretation is treated as a matter of secondary importance except in those cases in which residual stones, strictures, or tumors are a diagnostic problem. These cases are, however, a minority of the author's material, which comprises 261 essentially consecutive operations performed between 1950 and 1954, including 620 radiographs. The contrast medium used was Joduron (related to Diodrast) diluted to 20 per cent in order to prevent false pressure readings from spasm of ducts or sphincters.

A variety of conditions was diagnosed with the help of operative radiomanometric cholangiography. Their recognition on the operating table is essential if one desires to reduce the incidence of the so-called post-cholecystectomy syndrome. This syndrome is said to occur in 15 to 30 per cent of all cholecystectomized patients reported by others and is caused usually by conditions which were overlooked at operation but could have been remedied had adequate cholangiography been employed. Of the author's own series, 8.7 per cent suffered from persistent postoperative colic, while 30 per cent of his cholecystectomized patients, though freed of their colic, continued to have digestive complaints. Only 43.5 per cent were entirely symptom-free and only 31.8 per cent were able to live comfortably without dietary restriction. Fifteen patients (8.7 per cent of 170 adequately followed) required reoperation. Fourteen of these were again subjected to operative radiomanometric cholangiography, which was successful in all. Except in 1 case, the second operation produced a complete disappearance of symptoms. In this group, only 4 patients were found to have harbored residual stones. The cause of the post-cholecystectomy syndrome lies evidently elsewhere in the majority of cases. Radiomanometric cholangiography is thus used by the author predominantly for the diagnosis of conditions other than calculi, as papillitis, hypertonia of the sphincter of Oddi, hypotonia of biliary ducts, vesicular stasis, biliopancreatic reflux, normotonic and hypotonic pancreatitis, congenital anomalies, strictures, fistulas, and tumors.

Most statements made by the author are supported by statistics. Case reports are illustrated with excellent reproductions of radiographs. The chapter on the physiology and pharmacology of the biliary system contains more information than can be found in any standard textbook. The author is to be congratulated on his honesty in disclosing statistically the high incidence of morbidity after gallbladder surgery and on the accuracy and detail of his radiological studies. He has succeeded in proving that routine operative radiomanometric cholangiography is useful. It is unfortunate, however, that the book did not appear ten or fifteen years earlier, when it would have been an outstanding contribution to surgery and radiology. Now, with the advent of intravenous cholangiography, it is inevitable that much of the material will be outmoded in the very near future. Only three lines are devoted to a discussion of intravenous Biligrafin cholangiography in the present edition of the book

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

A Note on the Diagnosis of Meningiomas Within the Lateral Ventricles of the Brain. A. E. Wall. J. Fac. Radiologists **6**: 120–122, October 1954.

Lateral ventricle meningiomas are rare, only 60 having been described. They arise from the choroid plexus or velum interpositum and lie mainly in the trigone of the ventricle, with extensions of variable size forward into the body and temporal horn and into the occipital white matter.

Plain skull films reveal evidences of increased intracranial pressure. One-tenth of the cases show calcification of varying density, deep in the parietal region.

Ventriculography is the most frequent method of establishing an interventricular mass, demonstrating displacement of the lateral and third ventricles to the opposite side and outlining the tumor. Injection of a contrast medium into the carotid arteries has also been used, the obvious feature being displacement of the cerebral vessels corresponding to a deep parietal mass. Injection of the vertebral arteries showed one constant feature, namely, absence of the normal pattern of the choroid plexus.

K. Egner, M.D.
University of Arkansas

Technique for Visualisation of the Mental Foramen. A Case of an Expanding Soft Tissue Tumor in the Mental Foramen. G. Mårtensson and S. Ydén. Acta radiol. **42**: 266–268, October 1954.

The authors describe a special projection for demonstration of the mental foramen. An occlusal film is placed between the teeth of the upper and lower jaws as far laterally as possible; the roentgen tube is centered as for an axial projection of the mandible and tilted 30 to 40 degrees toward the affected side, so that the central ray is directed as far as possible at right angles to the transverse plane through the opening of the mandibular canal. A case of soft-tissue tumor demonstrated by this technic is reported.

Four roentgenograms; 1 photograph; 1 drawing.

Howard L. Steinbach, M.D.
University of California, S. F.

X-Ray Demonstrable Lesions in Occipital Headache. William R. Chambers. J.M.A. Georgia **43**: 871–874, October 1954.

Nine cases are presented in which intractable occipital headache was the presenting symptom and x-ray demonstration of lesions at or near the atlanto-occipital joint led to surgical intervention. Seven cases were examples of basilar impression with or without associated deformities. The headaches had failed to yield to conservative therapy, but with adequate surgery relief was obtained. The importance of x-ray examination in severe occipital headache is emphasized.

Six roentgenograms. Donald deF. Bauer, M.D.
Coos Bay, Ore.

THE CHEST

Pitfalls in the Roentgen Diagnosis of Pulmonary Disease. Philip J. Hodes. Minnesota Med. **37**: 699–703, October 1954.

This paper on the pitfalls in the roentgen diagnosis of pulmonary disease was given as the Carman Lecture before the Minnesota State Medical Association and is of a rather general nature. The author first stresses the importance of films of good technical quality and adequate clinical information in order that the best interests of the patient may be served. The tendency to ignore one part of the roentgenogram in favor of another is one of the most common pitfalls in radiology. Another is the tendency to relax when things seem obvious, radiographically. In differential diagnosis, the element of time plays an important role; sometimes it is misleading. One of the inponderables in the interpretation of chest roentgenograms is the mental attitude of the radiologist; on some days he tends to "over-read" and on other days to "under-read" what he sees. The variation in film interpretation between individuals is well known.

The advantages of body-section roentgenograms, the new image amplification tubes, and supervoltage roentgenograms are discussed.

Roentgenograms illustrating the above points were shown but are not reproduced.

Carcinoma of the Lung. A Report of 403 Cases. David P. Boyd, Magnus I. Smedal, Howard B. Kirtland, Jr., Gurney E. Kelley, and John G. Trump. J. Thoracic Surg. **28**: 392–408, October 1954.

This report is based on a study of 403 patients with carcinoma of the lung seen at the Lahey Clinic in the past fifteen years. The ratio of males to females was 6.6 to 1. Late diagnosis was found to be the chief controllable factor accounting for poor end-results, indicating the importance of frequent and repeated roentgenologic surveys of the chest and follow-up of all abnormal shadows and thoracic symptoms.

Of diagnostic studies, roentgenography is the most consistently accurate. The diagnosis was indicated by the radiologist in 90 per cent of the present series, but in many of these cases the disease was far advanced. Bronchoscopy was clinically positive in 61.8 per cent of 312 patients in whom it was performed and biopsy was positive in 42.3 per cent of that number. The Papanicolaou smear was positive in 50.4 per cent of 117 patients.

Resection was done in 104 cases: total pneumonectomy in 72 and lobectomy in 32. Ninety-seven patients received supervoltage radiation therapy in an attempt to make inoperable lesions resectable, surgery being performed midway through the course of radiation therapy. The authors are not impressed with this latter method, although certain lesions were made resectable. The neoplastic cells found in the resected lungs after radiation therapy were necrotic and non-viable.

The average survival of all patients was 10.7 months after discharge from the hospital. The average survival of all patients excluding those living five years was 7.9 months. The average life duration after x-ray therapy was also 7.9 months. Fifteen patients lived five years or more, representing 9.4 per cent of the total cases. One of the patients alive after five years received x-ray therapy only and at the time of the report had metastases. One patient died of recurrence at five years and one month. Two other patients who were alive were believed to have recurrences, one at five and one-half years and one at eleven years. Eleven patients were

living, apparently free from disease, from five to twelve years.

Two roentgenograms; 1 photomicrograph; 5 drawings; 27 tables. Rene G. FORTIER, M.D.
St. Paul, Minn.

A Clinical Survey of Adenomas of the Trachea and Bronchus in a General Hospital. Lamar Soutter, Ronald C. Sniffen, and Laurence L. Robbins. J. Thoracic Surg. **28:** 412–428, October 1954.

The authors present a survey of 56 cases of carcinoid adenoma and 4 of cylindroma of the trachea and bronchi diagnosed at the Massachusetts General Hospital between 1909 and 1954. Evidence of malignant activity was manifested in some of the carcinoid adenomas: mitoses were found in 6; microscopic evidence of penetration of the tumor through the capsule into adjacent lung was noted in 25 of 30 encapsulated tumors; secondary deposits in adjacent lymph nodes were found in 3 patients. In none of the cases were blood vessels invaded. Grossly, the carcinoid adenomas were well circumscribed and non-invasive. Their position in the bronchus was either intraluminal, extramural, or, most commonly, intraluminal with extramural extension, the bulk of the tumor lying outside of the bronchus. Intermittent or complete obstruction of bronchi by these growths caused considerable pulmonary suppuration and irreversible pathologic changes. Thirty-three patients had bronchiectasis, 20 pneumonitis, 11 empyema, 5 lung abscesses, 2 acute bronchitis, and 2 pulmonary fibrosis. In 7 of the 56 patients there was no evidence of permanent pulmonary damage.

Cylindromas occur most commonly in the trachea but are seen also in major bronchi. Their invasive nature is usually apparent. They form a polypoid intraluminal mass with or without extension through the wall. When the tumor extends beyond the wall of the trachea or bronchus, no capsule develops and invasion of the neighboring structure occurs. Mitoses are more common than in carcinoid adenomas. Three of the 4 cylindromas in this series originated in the trachea.

Roentgenographic findings are of major importance in establishing the diagnosis of bronchial adenoma. Even routine survey examinations will usually indicate the presence of some abnormality. Films of 46 patients in the authors' series were available, and in about half of these a part or all of the tumor was visualized. In the remainder, only those changes associated with bronchial obstruction were seen—collapse, bronchiectasis, acute pneumonitis, lung abscess. As a rule, the tumor was of homogeneous density. In 6 instances, ossification or calcification was seen within the mass. The outline was usually smooth or slightly lobulated, and submucosal or extrabronchial extension was often clearly demonstrated. The cylindromas were distinctive because of their irregular infiltrating appearance and their tendency to constrict long narrow segments of the trachea or bronchus. In some instances bronchography was used for demonstration of the tumor, but this method has been abandoned for the most part, in favor of laminagraphy.

The treatment of carcinoid adenomas is surgical extirpation. Cylindromas may be given a trial course of radiation therapy with the hope of reducing the size of the lesion before surgical intervention.

None of the patients with carcinoid adenoma died of the disease, and resection of the tumor with involved lymph nodes produced cures. In contrast to this, the cylindromas, although slow growing, had a very definite tendency to recur and metastasize. The authors feel that local excision of the carcinoid adenomas may be advisable when the histologic diagnosis is definite and when the remaining lung will be normal. In contrast to the bronchogenic carcinomas and cylindromas, the survival rate of patients with carcinoid adenoma is not greatly altered by an increase in the interval between diagnosis and resection.

Nine figures, including 5 roentgenograms; 3 tables.
Rene G. FORTIER, M.D.
St. Paul, Minn.

The Roentgen Aspects of Five Hundred Cases of Pulmonary Coccidioidomycosis. J. W. Birsner. Am. J. Roentgenol. **72:** 556–573, October 1954.

Coccidioidomycosis is clinically classified in three categories: (1) asymptomatic primary infection, usually without associated roentgen findings or pulmonary complications; (2) symptomatic primary infection, simulating a mild respiratory infection or, in a more severe form, showing infiltration of the lung parenchyma, with moderate hilar lymphadenopathy; (3) dissemination, sometimes with miliary lung lesions, extreme hilar adenopathy, and some residual fibrosis.

The author analyzes 500 cases of this disease diagnostically confirmed by complement fixation or microscopic evidence of the characteristic spherules. These cases are subdivided into three age groups. Twenty-five per cent of the patients were under thirteen years of age, constituting the "pediatric group"; less than 5 per cent were over sixty, the "geriatric group." The remainder are designated as the "intermediate group." Dissemination of the disease occurred in 20 per cent of the pediatric and intermediate groups, and death resulted in 6 and 12 per cent of these groups, respectively. In the small group of 24 patients over sixty years of age, 10 showed dissemination of the disease and 6 died.

Complications of pulmonary coccidioidomycosis, aside from dissemination, include pleural effusion, coccidioidoma formation, cavitation, bronchiectasis, and pulmonary fibrosis. In 25 cases in the series, or 5 per cent, there was concomitant pulmonary tuberculosis, but it is the author's opinion that the course of neither disease was appreciably altered by the presence of the other.

Erythema nodosum accompanied the pulmonary infection in 25 per cent of the cases. There is some fallacy in the prevalent view that erythema nodosum invariably signifies a benign course of the disease; 8 of the author's patients showed complications in the form of pulmonary cavitation or systemic dissemination. Pulmonary cavitation is classically described as thin-walled, without appreciable surrounding reaction. In this series, however, the majority of the residual cavities were secondarily infected and showed peripheral reaction.

Thirty-seven roentgenograms; 6 tables.
GEORGE E. LERNER, M.D.
Cleveland City Hospital

Tension Emphysema: Surgical Emergency in Infants. T. Y. Nelson and Douglas Reye. M. J. Australia **2:** 342–343, Aug. 28, 1954.

Lobar emphysema in infancy usually affects the right or left upper lobe or the right middle lobe. The affected lobe becomes greatly over-distended, causing

collapse of the other lobes and a considerable degree of mediastinal displacement. The condition may occur as an acute emergency and prove rapidly fatal if unrelieved, or there may be a history of wheezing or dyspnea persisting to a varying degree for months.

The cause of the emphysema appears to be abnormal development of the bronchus supplying the affected lobe, with a deficiency of cartilage, allowing bronchial collapse. A flap-valve mechanism is thus produced which permits the entrance of air into the lobe but prevents its expulsion.

Four cases are reported, of which 2 presented as emergencies. Both of these patients died, one after lobectomy. The other 2 patients were cured by lobectomy. A fifth child was awaiting surgery at the time of the report.

Tension emphysema is well known in pediatric literature and has been recognized for many years. The diagnosis, however, has presented considerable difficulty, the usual mistake being to confuse the condition with a tension cyst, as was done in one case of the series presented by the authors. Careful examination of the radiograph should show the presence of lung markings through the affected area, which is the distinguishing feature. Early diagnosis is imperative since corrective therapy is indicated. No report has been found in the literature of a patient having been treated conservatively over an indefinite period.

Five roentgenograms; 1 photomicrograph.

FRANK T. MORAN, M.D.
Auburn, N. Y.

Inflammatory Changes in the Bronchial Glands in Chronic Bronchitis, Demonstrated Bronchographically. Carl E. Gudbjerg and Gregers Thomsen. Acta radiol. **42**: 269–275, October 1954.

It is not generally appreciated that the pathoanatomic changes in chronic bronchitis can sometimes be demonstrated on bronchograms. One change is the filling of dilated glands and the efferent ducts of the glands in the bronchial walls with contrast medium. The changes resemble those observed in inflammatory conditions in the urethra, where filling of the paraurethral ducts is frequently demonstrable at urethrography.

Eight cases of chronic bronchitis are reported in which the efferent ducts of the bronchial glands were filled with iodized oil, though it has been stated by other authors that a water-soluble contrast substance is necessary to visualize these ducts. These changes must be accepted as indicating the presence of rather pronounced inflammatory changes of the mucosa.

Six roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

Benign Tin Oxide Pneumoconiosis. George E. Spencer and William C. Wycoff. Arch. Indust. Hyg. & Occup. Med. **10**: 295–297, October 1954.

Only 4 cases of benign tin oxide pneumoconiosis have been recorded in the American literature (Pendergrass and Pryde: J. Indust. Hyg. & Toxicol. **30**: 119, 1948; Cutter *et al.*: Ibid. **31**: 139, 1949; Dundon and Hughes: Am. J. Roentgenol. **63**: 797, 1950. Abst. in Radiology **52**: 282, 1949; **54**: 616, 1950; **57**: 279, 1951). The authors present a fifth case, in a 73-year-old Italian who had been exposed to tin oxide powder for a twenty-two-year period but was now retired.

During a mass survey, a chest roentgenogram of the patient was reported to the family physician as showing pneumoconiosis; the physician, in turn, made a diagnosis of "silicosis," apparently without going into the industrial history. The patient then entered suit against his previous employer for total permanent disability as a result of that condition. His only complaint was slight shortness of breath for one or two years. Examination showed essential hypertension, with mild congestive heart failure. Fluoroscopic study disclosed a generalized mottling throughout the lungs. Diaphragmatic motion was somewhat restricted by adhesions. Roentgenographic findings were characteristic of tin oxide pneumoconiosis. Pulmonary function studies showed a vital capacity of 2,900 c.c., with 2,400 c.c. expelled in the first three seconds. The maximum breathing capacity was 56 liters per minute, with a predicted normal of 92 liters per minute. Thus, the vital capacity was 70 per cent of normal and the maximum breathing capacity 61 per cent of the predicted normal.

This case illustrates the importance of taking a thorough industrial history rather than jumping to the conclusion that silicosis is present because a diagnosis of pneumoconiosis has been suggested.

Two roentgenograms.

A Program for Roentgen Examination of Hospital Admissions. Caroline W. Rowe. Texas State J. Med. **50**: 716–719, October 1954.

In 1949, the Texas Tuberculosis Association lent to the University of Texas Medical Branch at Galveston (John Sealy Hospital) a 70-mm. photofluorographic unit in order that roentgen examination of the chest on patients admitted to the hospital might become a routine procedure. Since initiation of the program the number of examinations has increased by eight times. In 1953–1954, 8,744 persons were examined, or 86.4 per cent of new clinic and hospital admissions. The 13 per cent not examined includes stretcher cases, small children, and private patients.

The photofluorographic unit adjoins the outpatient clinic, and the patient is referred for a chest roentgenogram upon registration at the hospital. One deficiency in the system is that the report is sent to the record room and is not brought directly to the attention of the attending physician.

During an eighteen-month period, 747 patients had 70 mm. films which were considered positive. In 85 instances, the 14 × 17-inch film proved to be normal; 251 showed cardiovascular disease, and 337 lung disease. Seventy-four patients suffered from miscellaneous conditions—from a fractured rib to mediastinal tumor. One hundred ninety-six of the patients with pulmonary disease were lost to follow-up study, emphasizing the need for adequate follow-up facilities. There were 86 cases of proved tuberculosis, 46 of which were found, on further study, to be active and 40 inactive, and 10 cases of proved bronchogenic carcinoma.

The cost of running the unit is estimated to be 75 cents per person having a photofluorogram, which is essentially the same as at other institutions.

An Experience with the Large Routine Chest Film in a Rural Hospital. J. W. Boyd. Ohio State M. J. **50**: 850–851, September 1954.

In 1952, it was decided to take routine admission chest films on all patients over twelve years of age

admitted to the Detwiler Memorial Hospital (Wauseon, Ohio) for twenty-four hours or more. Only one examination would be done on the same patient in a six-month period regardless of the number of admissions during that time. As the hospital has only 60 beds, with approximately 3,000 admissions yearly, it was felt that the expense incurred for the installation of a microfilm unit was not practical, and it was agreed to use the 14 × 17-inch film. A fee was charged to cover the expense of the radiology department but low enough not to discourage patients from having the examination.

While a perfect record has not been achieved, chest films have been obtained for at least 95 per cent of the patients. Only 3 patients refused to have the examination from a cost standpoint in a twelve-month period. During this period 1,205 admission films were taken. The films classed as "routine" do not include those of patients with chest complaints or patients suspected of having a chest disease. Of the 1,205 roentgenograms, 133 (11 per cent) showed some type of significant abnormality: abnormalities of heart and great vessels, 61; abnormalities of ribs, 11 (cervical ribs 10; metastatic destruction 1); diaphragm abnormalities, 4; lung disease, 50 (pneumonia, tuberculosis, fibrosis due to infection or occupation); neoplasms, 6. In only a small number of these cases had the diagnosis been proved at the time of this report.

The Use of Tomography for Unexplainable Infiltrations in the Upper Mediastinum of Infants. H. W. Kirchhoff. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 431–440, October 1954. (In German)

The author uses tomography of the upper mediastinum in infants to differentiate between various conditions such as enlarged thymus, mediastinal pleurisy, and enlarged mediastinal lymph nodes. The tomographs are taken in the lateral and anteroposterior positions with the infant held in a cellophane bag.

Cases are reported and a table sets forth the features differentiating enlargement of the thymus and mediastinal pleurisy.

Nine roentgenograms. JULIUS HEYDEMANN, M.D.
Chicago, Ill.

THE CARDIOVASCULAR SYSTEM

Ventricular Septal Defect, with a Note on Acyanotic Fallot's Tetralogy. Paul Wood, O. Magidson, and P. A. O. Wilson. Brit. Heart J. **16**: 387–406, October 1954.

Until the more recent intensive study of congenital heart disease, it has been the opinion of clinicians that ventricular septal defect is both a common and a benign condition. The authors are not wholly in accord with this view. In a series of 750 patients with congenital heart disease, they found 60 cases of isolated ventricular septal defect (8 per cent) and only one-third of the number were actually benign. In an additional 2.5 per cent of the series ventricular septal defect occurred as a part of Eisenmenger's complex, in 2 per cent in association with simple pulmonary stenosis, in 11 per cent as a part of the tetralogy of Fallot, and in 2 per cent in conjunction with other anomalies.

It is believed that the designation *maladie de Roger*, which has been applied to the anomaly since its original description by Roger in 1879, if used at all, should be limited to the mildest cases (22 in the present series). In this group the average difference in oxygen saturation between pulmonary artery and right atrial samples was 7.5 per cent, and the average pulmonary blood flow was 1.2 to 1.9 times the systemic flow; the electrocardiogram was normal, and the roentgen findings, at least in some cases, were within normal limits. The estimated transverse diameter of the defect was 3 to 5 mm. in this mild group.

Moderate and severe cases showed enlargement of both ventricles, gross dilatation of the pulmonary artery, varying degrees of pulmonary plethora (with or without hilar dance), and slight enlargement of the left auricle. In a few there was reduction of the amount of the shunt because of associated pulmonary hypertension, the raised pressure in the right ventricle producing a smaller pressure gradient across the septal defect. Pulmonary blood flow in these more severe cases ranged from 1.7 to 5 times the systemic.

Two cases of ventricular septal defect associated with aortic incompetence were seen. From the autopsy findings in 1 of these and descriptions of 5 cases from the literature it seems that a fibrous band from the edge of the defect in the septum deforms the anterior aortic cusp to render the valve incompetent. The features of aortic regurgitation plus the septal defect easily add up to a clinical diagnosis of patent ductus, and careful catheterization studies are necessary to prevent needless and dangerous surgery.

When pulmonary stenosis is found in association with a ventricular septal defect, the diagnosis is easily made at catheterization.

In the differential diagnosis of so-called *maladie de Roger* the authors consider the following: (1) pulmonary stenosis, (2) infundibular stenosis, (3) acyanotic Fallot's tetralogy, (4) mild aortic or subaortic stenosis, and (5) so-called innocent left parasternal murmur. In the moderate and severe cases one must consider also mitral regurgitation with counterclockwise rotation, atrial septal defect, and patent ductus when pulmonary hypertension is present.

Acyanotic tetralogy of Fallot occurs when right and left ventricular pressures are nearly the same. Ten examples were found among 80 cases of the tetralogy, but in 4 of them there was cyanosis on effort. The electrocardiogram often showed right ventricular hypertrophy in tetralogy and was always normal in *maladie de Roger*. The patients with acyanotic tetralogy always had some limitation of exercise tolerance; those with *maladie de Roger*, were symptom-free.

Fifteen illustrations, including 4 roentgenograms.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Pericardial Coelomic Cyst Simulating Chronic Pericardial Effusion: Report of a Case. Francis S. Gerbasi. Ann. Int. Med. **41**: 828–836, October 1954.

A 34-year-old white woman gave a history of "pressure pain" in the upper portion of the left anterior chest, of about two and one-half years duration. The pre-admission chest films showed what appeared to be an enormous cardiac shadow with a contour simulating a large pericardial effusion. Additional chest films, fluoroscopy, and rapid-sequence angiocardiograms were obtained, and the following comment was made: "Several possibilities should be included in the differential diagnosis. . . . Inter-auricular septal defect may produce extensive right auricular enlargement and this is suggested by the apparent enlargement in the region of the right auricle seen in lateral view. However, re-

view of previous routine survey films . . . shows that the apparent enlargement of the right side of the heart and the undivided portion of the pulmonary artery, suggested in the films taken at the University Hospital, is not actually the case. Also, it seems inconceivable that if this patient's abnormality represents heart disease she could now have no signs of cardiac failure. Another possibility is extensive pericardial effusion. However, fluoroscopically definite pulsations were seen at the borders of the mass, and again one is led to the conclusion that the abnormality represents a huge anterior mediastinal cyst, perhaps, but improbably, pericardial in origin. It is believed that the abnormality is benign, a huge cystic teratoma being a likely possibility."

The angiocardiograms showed without doubt that the large anterior mass was not cardiac in origin and did not appear to embarrass cardiac activity. It compressed the right lung, but no evidence of invasion of the intrathoracic vascular structures was found.

A fluid-filled cyst was suspected, and aspiration was performed, yielding 800 c.c. of clear, straw-colored fluid. The fluid was partially replaced by air, and additional x-ray studies were made, provoking the following comment: "Although previous reports have suggested rather dogmatically that the patient's abnormality represented a huge anterior mediastinal cyst, such does not appear the case. The findings at this time must be interpreted as due to a large pericardial effusion. This is somewhat difficult to understand in view of the patient's original film made three years previous to admission, which does not have the configuration of pericardial effusion." The film demonstrated air and fluid levels on both sides of the cardiac shadow, apparently filling the pericardial sac.

Operation was performed and a huge cyst was encountered in the anterior mediastinum and extrapleural space, encroaching upon the right pleural space, anterior, lateral, and posterior to the right lower and middle lobes. It extended up over the anterior mediastinum and down the left heart border into the anterior left chest. It was a U-shaped structure which lay anterior to the heart and pericardium. The postoperative course was uneventful.

The presence of an inverted U-shaped pericardial celomic cyst straddling the heart in the manner described has not been recorded previously.

Four roentgenograms; 1 photograph; 2 drawings.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Gargoylism with Cardiovascular Involvement in Two Brothers. R. W. Emanuel. Brit. Heart J. **16:** 417–422, October 1954.

The author reports 2 cases of gargoylism in brothers, one accompanied by autopsy findings. Both showed considerable enlargement of the heart shadows with prominent pulmonary arteries and suggestion of right ventricular hypertrophy. In the one who died there was nodular thickening of all 4 valves, endocardial and myocardial fibrosis, thickening of the chordae tendinae, and subintimal fibrosis of the coronaries which narrowed their lumens. The usual facial and other characteristics were present with the exception of kyphoscoliosis. Skeletal films are not reproduced.

Two roentgenograms; 3 photographs; 2 drawings; 1 electrocardiogram.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Interpretation of the Low (Cardiac) Archs of Cardiovascular Roentgen Silhouette in the Oblique Views. Jorge Meneses Hoyos and José Araujo. Rev. mex. de radiol. **8:** 233–252, October-November-December 1954. (In Spanish and English)

A careful review of the literature reveals no uniformity of opinion among either radiologists or cardiologists as to the interpretation of the lower cardiac outline in the oblique projection. After having done more than 50,000 fluoroscopies, as well as some angiocardiographic, kymographic, and experimental studies on cadavers, the authors recommend angles of 30° and 60° for oblique projections in the study of heart and great vessels. Their findings are as follows:

Left Anterior Oblique Projection; 30° Rotation: The spinal arch is formed mainly by the left ventricle. A small part in the upper portion is made up by the left atrium. With this slight angle of rotation, the spinal arch overlies the vertebrae. The thoracic (sternal or ventral) arch is made up mainly by the right atrium (the upper two-thirds), whereas the right ventricle occupies only the lowermost third.

Left Anterior Oblique Projection; 60° Rotation: The spinal arch is separated from the spine by a clear space. This arch represents the left atrium (forming the upper two-thirds); its lowermost part is formed by the left ventricle. The thoracic (sternal) arch is made up of the right ventricle. In some individuals the left ventricle forms the lowermost portion. The right atrium is not visible in this view.

Right Anterior Oblique View; 30° Rotation: The thoracic (sternal) arch is made up, in its upper portion, by the right ventricle and in its lower portion by the left ventricle. The spinal arch touches the shadow of the spine or is separated from it by a very narrow clear space. This arch normally consists only of the right atrium. If the left atrium becomes visible in this view, it is certainly enlarged.

Right Anterior Oblique View; 60° Rotation: The thoracic (sternal) arch is made up only by the right ventricle. The posterior or spinal arch is formed in its upper portion by the left atrium and in its lowermost portion by the right atrium.

Seventeen figures, including 7 roentgenograms.

GUILLERMO TRIANA, M.D.
St. Vincent's Hospital, N. Y.

Angiocardiography: A Guide to Mediastinal Exploration. Stanley M. Wyman. New England J. Med. **251:** 723–729, Oct. 28, 1954.

Angiocardiography is frequently a helpful guide to mediastinal exploration. By disclosing the vascular or non-vascular nature of a mediastinal lesion it helps the physician to decide whether or not exploration should be undertaken. If the shadow in question represents a vessel, no corrective procedure may be needed, or surgery may be contraindicated because of the danger of injury to a vascular structure. Conversely, if a mediastinal mass is shown to be separate from the vascular system, its nature can be identified only by histologic examination. In this instance, exact delineation of the adjacent vascular structures is of great help in planning the surgical approach.

The author illustrates these concepts by case presentations of a pulmonary artery aneurysm, absence of the left pulmonary artery, a dilated right subclavian artery lying between the esophagus and aorta, coarctation of the aorta, and pulmonary veins emptying into the

superior vena cava. In all these cases the patient might have been unnecessarily subjected to the discomfort and danger of thoracotomy if the true nature of the lesion had not been determined by angiocardiography. Other cases are presented in which the procedure strengthened the indications for operation.

Twelve roentgenograms.

THEODORE E. KEATS, M.D.
University of California, S. F.

Dysphagia and Unusual Radiographic Appearances Associated with the Variable Relationships of the Aorta and Lower Oesophagus. Eric H. Mucklow and Oliver E. Smith. J. Fac. Radiologists **6**: 88–95, October 1954.

The authors have studied the relationship of the aorta to the lower esophagus, particularly in respect to the following features:

1. Variability of the point at which the aorta crosses behind the lower esophagus and the difference of angulation at the crossing place.
2. Variability in the degree of anterior displacement of the lower third of the esophagus by the distal thoracic aorta.
3. The occasional incidence of dysphagia, apparently referable solely to compression of the esophagus by the aorta.
4. The probability that the cases in which an enlarged left auricle seems to displace the esophagus to the left may really be due to aortic displacement of the esophagus.

An explanation of the infrequent displacement of the esophagus to the left side by an enlarged left auricle is also offered.

Eight illustrative cases are reported.

I. MESCHAN, M.D.
University of Arkansas

A Study of the Correlation Between Roentgenographic and Post-Mortem Calcification of the Aorta. Julian B. Hyman and Frederick H. Epstein. Am. Heart J. **48**: 540–543, October 1954.

The authors found roentgenographic evidence of calcification in the thoracic and abdominal portions of the aorta in 26 per cent of the males and in 23 per cent of the females, past the age of forty, in a group of 568 patients. This unexpected finding led to a study of autopsy specimens of the aortas from patients in whom roentgen films had been made during life. Seventy-two thoracic and 55 abdominal aortas were investigated.

Of the thoracic aortas, 18 showed roentgen evidences of calcification, which was verified postmortem. Five were classified as questionable, and in these no calcification was demonstrated at autopsy. Of the remaining 49, in which no calcification was evident roentgenographically, 4 showed calcification at autopsy.

Of the abdominal aortas, 20 showed calcification roentgenologically and the finding was verified postmortem. Four classified as doubtful or questionable on the basis of the roentgenogram revealed calcification postmortem. Of the remaining 31, which were negative roentgenologically, 5 showed calcification.

This group of 72 patients included 35 males and 37 females. The males and females were about equally divided in age groups above forty. Nineteen males and 19 females presented evidences of calcification. The incidence was high in persons above the age of sixty.

The pathologic specimens were graded into 3 groups: Grade I, discrete, small, raised lesions; Grade II, large non-confluent lesions; Grade III, large confluent lesions, frequently ulcerated. In over 80 per cent of the cases in which calcification was present postmortem, the atherosclerotic lesions were advanced (Grade III), indicating that calcification usually signifies advanced disease. Only 10 per cent of the cases showed advanced disease without postmortem evidences of calcification.

Two tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Translumbar Arteriography in Intrinsic Disease of the Abdominal Aorta and Its Branches. Benjamin Felson. Am. J. Roentgenol. **72**: 597–606, October 1954.

This paper is based on experience gained from 1,000 cases of abdominal arteriography. The procedure is represented as a reliable diagnostic implement and therapeutic guide in diseases of the abdominal aorta and its branches.

Aneurysms of the aorta and its branches are evaluated by arteriography. With improved surgical technics for correction of these abnormalities, preoperative determination of the extent of the disease is of increasing importance. Similarly, preoperative determination of the structure of arteriovenous fistulas is of great aid.

The significance of arteriography in the study of thrombosis in the aorta and its branches is apparent. Not only will it frequently establish the diagnosis, but it will aid the surgeon in selecting and planning the operative procedure. For evaluation of the iliac and proximal femoral vessels, the technic is modified. The injection is made more distally in the aorta, and a greater amount of contrast medium is used. The status of the wall and lumen of the vessel and extent of collateral circulation may be determining factors in deciding the feasibility of surgical correction.

In the author's experience, evaluation of renal hypertension by arteriography has been relatively disappointing. In the few cases observed, the vascular insufficiency tended to be intrarenal and the affected vessels were too small for arteriographic demonstration.

Fourteen roentgenograms.

GEORGE E. LERNER, M.D.
Cleveland City Hospital

The Diagnosis of Cardiac Shunts by Intravenous Angiocardiography. John Lind, Rowena Spencer, and Carl Wegelius. Brit. Heart J. **16**: 407–416, October 1954.

This study is based upon a series of angiocardiograms in infants and young children taken simultaneously in both the right and left anterior oblique projections at a speed of ten to twelve exposures a second in each projection. The contrast medium was 70 per cent Umbradil, 1.0 to 1.5 ml. per kilogram of body weight, injected rapidly through the malleolar vein in infants and the antecubital vein in the other children.

The demonstration of any shunt is dependent upon a difference in radiopacity between two chambers of the heart, which in turn depends upon the inflow of contrast material. Simplifying the authors' explanation, it may be said that there are two signs of a shunt: (1) appearance of contrast medium at a place (and time) at which it could arrive only through a shunt, and (2)

dilution of the opaque material by non-opacified blood from another chamber or vessel. Since opacification of a given chamber depends upon the phase of the cardiac cycle, failure of visualization may be the result of the medium reaching the heart at an inopportune time. An atrial septal defect, for example, may not be demonstrated on the first cycle if the atrium was in mid or late diastole (nearly full of non-opacified blood) when the medium arrived.

Right-to-left interatrial shunts are the ideal ones for demonstration angiocardiographically, since there is a maximum difference in the concentration of contrast medium on the two sides of the heart at the beginning of the study. When the medium reaches the right atrium, no other chamber of the heart is opacified, and it streams through the interatrial defect into a left atrium which is radiographically empty. To demonstrate a small interatrial shunt it is important that an axial view of the interatrial septum be obtained. If the plane of the septum is directly "end-on," a jet of medium passing from the right to the left atrium will be seen.

Right-to-left ventricular shunts are less easily visualized because the medium has already become diluted in the atrium. In these shunts an actual jet of medium is not seen, but there is rather a diffuse opacity over all or part of the ventricle. In some cases, with a high interventricular defect or an overriding aorta, the blood may be shunted from the right ventricle directly into the aorta and the diagnosis will be made from early visualization of the latter structure. Opacification of the distal aorta while the transverse and ascending aorta remain invisible is indicative of a right-to-left shunt through a patent ductus.

A left-to-right shunt is characterized by a prolonged opacification of all the chambers of the heart, a continued visualization of the blood that is withdrawn from the systemic circulation and recirculated through the heart and pulmonary vessels. This short-circuited blood increases the volume that must be handled by the affected chambers and results in their dilatation. An anatomic consequence of this decrease in the volume of the systemic circulation is the comparatively small caliber of the aorta, and as a result of the concomitant increase in the volume of the lesser circulation, there is a profuse pulmonary vascularity.

A persistent opacification of the right atrium and ventricle and the pulmonary arteries is presumptive evidence of interatrial communication with a left-to-right shunt, if it can be established that the contrast material in the right heart can have come only from the left. Opacification of the right ventricle, pulmonary artery, and left atrium, with poor visualization of the aorta, is indicative of a left-to-right interventricular shunt. A left-to-right shunt through a patent ductus is indicated by loss of concentration of the medium in the pulmonary artery, due to influx of non-opacified blood from the aorta, and persistent visualization of the pulmonary artery, though the latter is rather difficult to demonstrate.

Sixty-eight roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Left-Sided Superior Vena Cava. Maurice Campbell and D. C. Deuchar. Brit. Heart J. **16**: 423–439, October 1954.

The significance of a left superior vena cava is clearly established by this analysis of 46 cases. Embryologically, the left superior vena cava is explained by a failure of obliteration of the left duct of Cuvier, resulting in a symmetrical pattern instead of the normal asymmetrical one. Most cases are found to accompany more serious lesions. In 28 of the authors' cases the heart and abdominal viscera were normally placed, while in 18 there was some form of visceral transposition. When the heart and all the abdominal viscera are transposed to form a mirror image of the normal, the left superior vena cava is the only one present, emptying normally into the atrium. Otherwise there is usually a right superior vena cava as well. This enters the right atrium in normal fashion, while the left drains into the same atrium through the coronary sinus. Occasionally the two venae cavae may communicate through an innominate vein.

In a few cases the left superior vena cava emptied into the left side of an atrium that was without an interatrial septum or at least with a large septal defect, but in no instance did the left superior vena cava empty into a normal left atrium to produce a right-to-left shunt. In 4 cases of incomplete transposition of the viscera, the inferior vena cava was absent and the blood from the lower part of the body reached the heart by way of the portal and azygous systems.

On angiocardiography there is generally no difficulty in recognizing a left superior vena cava, if the investigation is from the left arm. Bilateral superior venae cavae may both be demonstrated. There is no doubt that this anomaly complicates cardiac catheterization. The angle between the left subclavian vein and the left superior vena cava is acute and may interfere with passage of the catheter. Even if the catheter tip enters the right atrium, it is not easy to manipulate it into the right ventricle and pulmonary trunk, and sampling of blood is difficult. For this reason, if a left superior vena cava is suspected, heart catheterization is best performed through a vein in the right arm.

A left superior vena cava does not as a rule affect the prognosis of the patient's condition, nor does it cause any difficulty to the surgeon in operating for whatever cardiac disease may be associated. When found by chance at operation, the vessel should not be ligated, for it may be playing an important part in the circulation.

Eleven roentgenograms; 3 diagrams; 1 drawing; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

A Congenital Subclavian Arteriovenous Fistula and a Truncus Brachiocephalicus Totalis in the Same Patient. O. Peräsalo and K. E. J. Kyllönen. Am. Heart J. **48**: 465–470, September 1954.

The authors give the case history of a 34-year-old female in whom a congenital subclavian arteriovenous fistula was diagnosed preoperatively and corrected surgically. This patient also presented the rare anomaly of a truncus brachiocephalicus totalis, as well as a small patent ductus arteriosus.

Congenital arteriovenous fistulas are comparatively rare. Among 447 cases of arteriovenous fistula collected from the literature, Callander (Johns Hopkins Hosp. Rep. **19**: 259, 1920) found only 3 that were definitely congenital in origin; Pemberton and Saint (Surg., Gynec. & Obst. **46**: 470, 1928) reported 9 cases in the material of the Mayo Clinic from 1916 to 1928, and Adams (Surg., Gynec. & Obst. **92**: 693, 1951) collected 22 cases of congenital arteriovenous and cirsoid aneurysms.

Aortography in the authors' patient, with the catheter in the left subclavian artery, showed a large single vessel arising from the left side of the aortic arch, a truncus brachiocephalicus totalis (also described in the literature as an innominate artery). From this vessel the right brachiocephalic trunk, 22 mm. in diameter, passed in a horizontal direction to the right side of the chest, on a level with the superior margin of the sternum. Almost immediately after the bifurcation of the right common carotid artery, the contrast medium passed by way of an obvious shunt into the subclavian vein and thence into the vena cava superior. The fistula was observed to be behind the right clavicle, at the junction of its middle and inner thirds. A further finding was a small patent ductus arteriosus, but symptoms referable to this anomaly were mild. The subclavian arteriovenous fistula was successfully obliterated by ligation.

Three roentgenograms.

HENRY K. TAYLOR, M.D.
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Simple Pulmonary Stenosis. D. W. Barritt. Brit. Heart J. **16:** 381–386, October 1954.

In a consecutive series of 33 patients with pulmonary stenosis, ranging in age from infancy to thirty-seven years, 23 were asymptomatic. Dyspnea, limitation of activity, and fainting were the principal symptoms in the remaining 10. Several showed peripheral cyanosis, and in 4 there was cyanosis of the central type. Slight finger clubbing was noted in 3, 1 of whom had subacute bacterial endocarditis. Pulmonic systolic murmurs and thrills were present in all.

On x-ray examination, only 1 patient showed any increase in the transverse diameter of the heart, and only 5 had any suggestion of decreased vascular shadows in the lungs. Twenty-three showed post-stenotic dilatation of the main pulmonary artery segment.

The electrocardiographic pattern varied from normal to severe right ventricular strain. Cardiac catheterization showed increased right ventricular pressure in the 8 cases in which the test was performed.

Only 4 of the 10 patients with symptoms showed progression in severity and none showed x-ray evidence of increasing heart size. One patient had two attacks of subacute bacterial endocarditis; another had one attack.

Increasing symptoms, an accentuated "a" wave in the jugular pulse, electrocardiographic evidence of severe right ventricular dominance, and diminished pulmonary vascular markings are considered indications for valvulotomy.

Four roentgenograms; 2 electrocardiograms; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Pulmonary Valvular Stenosis with Intact Ventricular Septum: Isolated Valvular Stenosis and Valvular Stenosis Associated with Interatrial Shunt. Sidney S. Sobin, Merl J. Carson, John L. Johnson, and Charles R. Baker. Am. Heart J. **48:** 416–432, September 1954.

The recognition of pulmonary valvular stenosis depends upon clinical and specialized laboratory technics. Many of the patients are virtually symptom-free. The authors studied and correlated the signs and symptoms with the objective findings in 28 cases, 12 of isolated pulmonary valvular stenosis and 16 with an associated interatrial septal defect or patent foramen ovale.

The symptoms and findings were more or less the same in both groups. Easy fatigue and exertional dyspnea were characteristic. Cyanosis was absent in the first group and present in half of the group with an interatrial defect or patent foramen ovale. In both groups, systolic thrills and loud basal systolic murmurs were heard, and the pulmonic second sound was absent or diminished in the majority of cases. The electrocardiogram revealed right ventricular hypertrophy in all but 2 patients.

The conventional x-ray examination disclosed hearts of abnormal size, with right ventricular enlargement, prominent pulmonary artery segments, and diminished vascularity in the lungs. Angiocardiographic examination showed slow filling and emptying of the pulmonary vessels, a filling defect between the outflow tract of the right ventricle and the pulmonary artery, and a post-stenotic dilatation. In the group with interatrial defect, only 5 showed early filling of the left auricle, through the defect. None showed premature opacification of the aorta.

Cardiac catheterization revealed normal or low pressure in the pulmonary artery and increased pressure in the right ventricle, proportional to the degree of valvular stenosis. Meticulous exploration of the region of stenosis characteristically shows an increasing negative pressure as the catheter is withdrawn from the pulmonary artery into the stream of the valve orifice (Venturi curves) and an abrupt change to the high pressure of the right ventricle. In 6 cases with atrial septal defect or patent foramen ovale, the cardiac catheter was passed from the right into the left atrium.

Four roentgenograms; 2 pressure tracings; 2 tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Anomalous Pulmonary Vein Drainage into the Coronary Sinus. M. W. Arthurton, R. V. Gibson, and G. M. Woodwark. Brit. Heart J. **16:** 460–462, October 1954.

The authors report a case in which it was believed, from the findings on catheterization and angiocardiography, that all the pulmonary veins as well as a left superior vena cava emptied into an aneurysmal coronary sinus. Samples of blood from the right heart, pulmonary artery, and femoral artery showed equal oxygen levels, higher than that in the superior vena cava. The diagnosis was not verified anatomically since surgery was not indicated and the child (five years old) was still alive.

A plain film showed extensive right heart enlargement and marked pulmonary engorgement.

Three roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Paraplegia Following Translumbar Aortography. Saul Boyarsky. J.A.M.A. **156:** 599–602, Oct. 9, 1954.

This is a detailed report of the development of paraplegia below the eighth thoracic cord segment after translumbar aortography, with partial recovery. The aortic puncture at L-2 was somewhat difficult, since six or eight attempts were necessary; otherwise no unusual feature was present. The episode of paraplegia, with partial recovery at the time of discharge, was believed to be best explained by sudden ischemia of the cord or direct toxic action of the opaque medium (Urokon Sodium 70 per cent) along the vascular bed of an

anterior artery that simulated ischemia. Other possible causes considered were mechanical trauma to the spinal cord or its vessels by needle puncture, exacerbation of a pre-existing disease, resulting in arterial embolism or hemorrhage into a previously silent cord tumor, and contamination of the opaque medium.

A review of the literature disclosed 2 deaths and 1 case of paraplegia following aortography. Injection or diversion of the medium into the celiac axis, renal arteries, or superior mesenteric artery seems to be a major complication. Shunts that divert the contrast material into the brain or spinal cord circulation may also result in serious reaction.

[At the University of Michigan Hospital there has been one death attributed to aortography. In this case a large amount of contrast medium entered both renal arteries. Univ. Michigan M. Bull. **20**: 201, 1954.—J.P.F.]

One roentgenogram. JOHN P. FOTOPOULOS, M.D.
University of Michigan

Spinal Cord Damage in Abdominal Aortography. Ragnar Hol and Odd Skjerven. Acta radiol. **42**: 276–284, October 1954.

Repeated injection of a 70 per cent solution of contrast medium of the Diodrast type into the abdominal aorta of rabbits was found to give rise to toxic damage of the spinal cord. This was shown by an intravenous dye technic to be the result of increased capillary permeability. With the animal in the prone position, damage to the cord was much less likely to occur.

The animals receiving the injection in the supine position showed spasm and paralysis. Roentgenograms obtained during the injection of the contrast material demonstrated the filling of the spinal arteries with the animal supine and absence of filling in the prone position. This is due to the high specific gravity of the contrast material, which passed through the vessels located in the most dependent position.

Five figures, including 3 aortograms; 1 table.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

The Importance of Radiology in Geriatrics. Juan José Quezada. Rev. mex. de radiol. **8**: 253–264, October-November-December 1954. (In Spanish)

The title of this paper is somewhat misleading, since the discussion is limited to arterial diseases. For arteriography, general or local anesthesia is used. The injection may be made percutaneously or directly into an artery which has been dissected out. In the absence of circulatory obstruction, 35 c.c. of Neo-Iopax (concentration not given) is injected in eight seconds. If arterial obstruction is present, 12 to 15 c.c. of medium is introduced in ten to fifteen seconds; 30 × 40-cm. films are used for the thigh and leg. When obstruction is present, the major artery is compressed by digital pressure above the injection site.

For retrograde arteriography the patient is prepared with enemata and Nembutal. A No. 17 needle is attached to one end of a section of polyethylene catheter, the other end of which is beveled. A short beveled two-way needle is introduced into the artery in its longitudinal axis and 3 c.c. of sodium citrate solution is injected. Following this, in order to study the common iliac arteries, the polyethylene tube is introduced through the beveled needle for approximately 5 inches. The patient is then placed in Trendelenburg position and a scout film is taken to visualize the catheter. If it is in the desired position, the needle is removed from the artery over the catheter. Through the No. 17 needle, attached to the free tip of the catheter, 20 c.c. of Novocaine (1 per cent solution) is then injected into the artery to prevent vascular spasm and, after this, 15 c.c. of sodium citrate. Digital pressure is made on the artery below the site of puncture and 20 c.c. of Neo-Iopax is injected in three to five seconds. The x-ray exposure is made at the end of injection. By this technic the condition of the vessels proximal and distal to the occlusion can be studied, as well as the distribution, extent, and degree of the collateral circulation.

In senile arteritis, it is possible to visualize the arteries on a scout film because of the deposition of calcium in the vessel walls. Arteriography gives additional information by visualization of changes in the major vessels and demonstration of the collaterals. This enables one to distinguish two different varieties: (*a*) the phlegmonous type, associated with infectious lesions, in which the arteries show good patency but thickened walls and tortuous and irregular contours; (*b*) the gangrenous type, with a clinical course like that of an ordinary senile gangrenous process. Vascular occlusions are as a rule present in the latter variety. Arteriography is also useful for the study of aneurysms, traumatic, syphilitic, or spontaneous in etiology.

The author considers also the cardiovascular configuration as seen in different projections. By studies of anatomical preparations, as well as injections into the chambers of the heart in cadavers, followed by x-ray examination of the chest in various projections, he arrives at several conclusions: (1) The left medium arc of the radiographic shadow in postero-anterior projection corresponds usually to the pulmonary artery and its left branches. (2) The opening of the inferior vena cava is below the dome of the diaphragm. (3) The highest portion of the radiographic shadow on the left side in the postero-anterior projection corresponds to the brachiocephalic veins. (4) In the left anterior oblique projection, the visualization of the auricle and ventricle along the dorsal (spinal) arc depends on the angle of rotation of the patient. The maximum view of the auricle is obtained when this angle is equal to or less than 30°.

Twelve roentgenograms.

GUILLERMO TRIANA, M.D.
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Peripheral Arteriosclerosis. Clinical and Arteriographic Evaluation with Reference to Conservative Surgical Treatment. H. P. Totten. Angiology **5**: 355–380, October 1954.

Successful conservative surgery in peripheral arteriosclerosis is largely dependent upon the integrity of the arteries below the bifurcation of the popliteal.

Because of the tendency for thrombosis to occur in tibial arteries secondary to segmental obstruction of the aorta and the iliac and femoral arteries, emphasis is placed upon early recognition of the latter and definitive surgical treatment. Claudication is the most important subjective complaint, while reduction of the oscillometric index and the presence of a thrill and bruit over the major artery are among the earliest objective findings. Pain at rest, frequently combined with trophic changes of the leg and foot, indicates an advanced degree of ischemia. Under these circum-

stances, occlusion of major arterial channels below the knee is the rule.

In segmental occlusion at any level above the popliteal bifurcation with patent vessels below the knee, a good nutritional state, except for muscular atrophy, is usually found. Such cases are well suited to conservative surgery.

Arteriography, although unnecessary in routine examination, is useful in patients in whom surgery is contemplated. It will answer precisely two fundamental questions: the location and extent of obstruction and (2) the condition of the distal arteries. The technic of translumbar arteriography employed by the author is essentially that described by Smith, Rush, and Evans (J.A.M.A. **148:** 255, 1952. Abst. in Radiology **60:** 627, 1953), with a slight modification. A venotube is used as a connector between the syringe and needle because it is non-distensible, is long enough to keep the syringe well out of the roentgenographic field, and at the same time obviates the possibility of inadvertently displacing the needle from its position in the aorta.

Thrombosis of the aorta and iliac arteries is of two types, with distinct clinical and pathological characteristics: One, the Leriche syndrome, occurs in an early age group, when the disease process is localized in the abdominal aorta and iliac arteries. This condition is well suited to direct surgery. The other, aorta-iliac thrombosis, is found in the older age group with diffuse arteriosclerosis; direct surgery is seldom practical for these patients.

Twelve cases are reported.

Twenty-three roentgenograms; 4 photographs; 8 tables.

Angiographic Observations on the Development of Vascular Disease and Circulatory Disturbances, with Special Attention to the Terminal Vessels. E. Vogler. Fortschr. a. d. Geb. d. Röntgenstrahlen **81:** 479–497, October 1954. (In German)

The author uses serial angiography to demonstrate the entire vascular supply of the lower extremity. Two injections are used; following the first, only one film is taken. Seven minutes later, a second injection with a 50 per cent contrast medium is made and five to seven films are taken at three-second intervals, with two additional films at five- and ten-second intervals. The examination is completed in about thirty to forty-five seconds. Occasionally a third injection following administration of Hydergin (Sandoz), which is a vasodilator, is made and the serial studies are repeated.

The author discusses normal findings and then gives examples of several pathological conditions. Serial angiography provides information not only as to anatomical conditions, but also concerning functional pathology. The author believes that pathological conditions are initiated in the terminal vessels (arterioles, capillaries, and venules). This is further evidenced by normalization of some pathological conditions following the administration of a vasodilator.

Seventeen roentgenograms; 10 drawings.

JULIUS HEYDEMANN, M.D.
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Venous Occlusion of Lower Extremities in Paraplegic Patients. Ernest Bors, Chester A. Conrad, and Theodore B. Massell. Surg., Gynec. & Obst. **99:** 451–454, October 1954.

Ninety-nine patients with injury to the spinal cord or cauda equina underwent bilateral phlebography of the lower extremities. Thirty cubic centimeters of a 35 per cent solution of Diodrast was injected into a superficial vein of the dorsum of each foot within one minute, with tourniquets in place at the mid-thigh and ankle of each leg. Three x-ray exposures were made immediately of the lower leg, thigh, and pelvis, respectively. Thus it was possible to study the deep intercommunicating and collateral venous systems.

Fifty-eight patients (58.6 per cent) showed roentgenographic evidence of unilateral or bilateral deep venous occlusion. Venous occlusion was significantly more frequent in patients with flaccid than in those with spastic paraplegia. One-third of all venous blocks were observed within the first year after injury.

The incidence of occlusion was highest in the veins of the thigh, followed by those of the lower leg, and finally the pelvic veins. The left lower extremity was involved somewhat more often than the right but the difference was not considered significant.

Swelling and edema of the lower extremities were noticed in 14 patients, but only in 10 of these was there phlebographic evidence of venous occlusion.

The authors do not use anticoagulant therapy in paraplegic patients. In spite of this, only 3 cases (0.3 per cent) of pulmonary embolism (not included in this series) occurred among 1,000 paraplegic patients, with 1 (0.1 per cent) fatality.

The common symptoms of venous occlusion are practically absent in patients with paraplegia because the neurologic deficit abolishes such features as pain, tenderness on examination, and Homans' sign; while fever, tachycardia, increased sedimentation rate, and malaise may well be caused by pyelitis, decubitus ulcers, or other complications. The positive phlebogram permits the diagnosis of deep occlusion.

Two tables.

MORTIMER R. CAMIEL, M.D.
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Phlebographic Study of the Swollen Arm Following Radical Mastectomy. S. Schorr, A. Hochmann, and M. Fraenkel. J. Fac. Radiologists **6:** 104–108, October 1954.

In an effort to evaluate the etiology of edema of the upper extremity following radical mastectomy, three groups of patients were studied by phlebography (30 c.c. of 35 per cent Diodrast into an antecubital vein). Group I consisted of 30 subjects with normal arms, undergoing pyelographic examination. In these it made no difference whether the injection was made into the basilic or cephalic vein. Group II comprised 15 patients with swollen arms following radical mastectomy, while Group III consisted of 18 patients without swelling after operation. No correlation was apparent between the state of veins in the axillary region as seen in the phlebogram and swelling of the arm. The authors believe that apparent deformities of the vein, such as narrowing or defective filling, are pathologic only if accompanied by formation of collaterals. The cephalic vein was visualized in 16 of the 18 patients in Group III, and it is suggested that "this may prove the importance of the patency of the cephalic vein in preventing postoperative swelling of the arm." [One may question the validity of this conclusion, since 12 of the 15 cases in Group II (with edema) are also said to have had demonstrable cephalic veins.—H.J.B.]

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University of Arkansas

THE DIGESTIVE SYSTEM

The Gastroesophageal Vestibule, Its Normal Function and Its Role in Cardiospasm and Gastroesophageal Reflux. Franz J. Ingelfinger, Philip Kramer, and Guillermo C. Sanchez. Am. J. M. Sc. **228**: 417–425, October 1954.

The gastroesophageal vestibule is that portion of the esophagus lying between the inferior esophageal sphincter and the gastroesophageal junction. It is about 2 to 3 cm. in length.

Direct measurement of intraluminal esophageal pressures shows that immediately upon swallowing there is an increase in pressure throughout the body of the esophagus but not in the vestibule. Moreover, the peristaltic pressure wave that can be recorded in the body following swallowing is not propagated into the vestibule. From these and other observations, the authors conclude that the vestibule has characteristic motor function differentiating it from the remainder of the esophagus.

In cardiospasm, the narrowed segment which can be demonstrated radiographically corresponds to the vestibule, while the body of the esophagus shows decreased tone and impaired propulsive motility. Therefore, these two esophageal regions normally must have different motor functions. When Mecholyl was administered to patients with cardiospasm, it produced spasm of the lower portion of the body of the esophagus and relaxation of the narrowed vestibular portion. Banthine given to normal subjects in doses believed to be anticholinergic resulted in abolition of the peristaltic wave normally initiated by swallowing and in a failure of relaxation of the vestibule so that barium mixture was retained in the esophagus, even in the upright position, for more than ten minutes. These effects of Mecholyl in cardiospasm and of Banthine in normal subjects suggest that the vestibule and the body of the esophagus react inversely to cholinergic stimuli.

In cardiospasm, the vestibule exhibits achalasia, that is, failure of relaxation. The opposite condition, chalasia or failure of the vestibule to remain contracted between swallows, also exists and may have even wider implications than has achalasia. At present, a major role in the prevention of gastroesophageal reflux is credited to the diaphragm and to angulation of the lower esophagus; intrinsic esophageal mechanisms are either not considered or are assigned secondary roles. The existence of gastroesophageal reflux in patients who have no evidence of diaphragmatic herniation suggests that vestibular dysfunction underlies some types of reflux. Even in patients with diaphragmatic hernia, the adequacy of the vestibular mechanism may prove as important as the direct action of the diaphragm in determining whether or not material regurgitates from the stomach into the esophagus.

Eight roentgenograms; 1 drawing; 1 pressure record.

JOHN J. CRAVEN, M.D.
Cleveland Clinic

Small Gastric Cancer. Mandred W. Comfort, Howard K. Gray, Malcolm B. Dockerty, Robert P. Gage, George R. Dornberger, Jorge Solis, Dean P. Epperson, and Robert A. McNaughton. Arch. Int. Med. **94**: 513–524, October 1954.

The authors reviewed the records of 226 gastric adenocarcinomas, 4 cm. or less in greatest diameter, treated by resection at the Mayo Clinic in the years 1940 to 1945, inclusive. These small neoplasms composed one-fourth of all gastric cancers for which resection was performed. As compared with gastric cancers of all sizes, they displayed a slightly higher percentage of the lower grades of malignancy, a lower incidence of metastases, a higher incidence of symptoms of the ulcer type, and a higher secretory activity. When the series itself was subdivided according to the size of the lesion, it was found that the smaller the growth the lower was the incidence of higher grades of malignancy and of metastases, the higher was the incidence of symptoms of ulcer type, the longer was the duration of the symptoms, and the higher was the gastric secretory activity.

Roentgen examination of the stomach was carried out in 222 of the cases. In 8 of these an intragastric lesion was not visualized. In the remaining 214, intragastric lesions were seen. In 5 of the 214, the diagnosis was gastritis or hypertrophy of the pyloric muscle, or both, and in 74, 80, and 55 of the cases the diagnosis was, respectively, carcinoma, lesion, and gastric ulcer. In short, the roentgenologic findings led to a diagnosis of gastric cancer in 33.3 per cent, and suggested this diagnosis in 36 per cent; in the remaining 30.7 per cent, the roentgenologist did not detect features suggestive of cancer. When the diameter of a lesion was 1 cm. or less, a correct diagnosis of carcinoma was made in only 11.1 per cent of the cases; when the greatest diameter of the lesion was 3.1 to 4 cm., the percentage rose to 46. For the smaller lesions, the diagnosis was gastric ulcer in 50 per cent of the cases as compared to 12.6 per cent for the large lesions.

The smaller the gastric cancer, the higher was the five-year survival rate. The hospital mortality rates for small gastric cancer were less than those for gastric cancers of all sizes and were of the same order as those for benign gastric ulcer.

For small gastric cancers five-year survival rates were higher when the symptoms were of the ulcer type, or of long duration, or when gastric secretory activity was high, than when symptoms were of the non-ulcer type or when gastric secretory activity was low.

Eight graphs; 2 tables.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

Gastric Volvulus. Part I. Charles Gottlieb, David Lefferts, and Samuel L. Beranbaum. Am. J. Roentgenol. **72**: 609–615, October 1954. **Part II. Idiopathic Gastric Volvulus.** David Lefferts, Samuel L. Beranbaum, and Charles Gottlieb. Ibid., pp. 616–624. **Part III. Secondary Gastric Volvulus.** Samuel L. Beranbaum, Charles Gottlieb, and David Lefferts. Ibid., pp. 625–638.

In the first of the three papers listed above, the authors review the literature on gastric volvulus and on this basis outline briefly the anatomical considerations and etiologic theories. In summary, they state that volvulus may be secondary to an intrinsic lesion of the stomach or an extrinsic lesion in the neighboring structures. At times no cause can be demonstrated. Among extrinsic factors, they mention as most important an abnormally long gastrohepatic or gastrocolic omentum. Other conditions predisposing to volvulus are diaphragmatic hernia (through a lengthening of the mesentery), "aerocoly" or distention of the colon, and hepatodiaphragmatic interposition. In this last condition the transverse colon or splenic flexure rolls upward

and forward, and the greater curvature is pulled up by the gastrocolic omentum.

The authors quote von Haberer's classification (see Singleton: Radiology **34:** 53, 1940), which recognizes two main types: (1) organo-axial (rotation of the stomach upward and around its long axis, *i.e.*, around the coronal plane) and (2) mesenteroaxial (rotation from right to left, or left to right, about the long axis of the gastrohepatic omentum). Further classification may be made on the basis of the extent of rotation, its direction, etiology, and severity.

Gastric volvulus may be present without symptoms or may produce mild or acute upper abdominal distress, depending upon the degree of rotation. Volvulus up to 180 degrees may be present without obstruction or strangulation of blood supply, and may undergo spontaneous resolution. Beyond 180 degrees rotation, the patient presents an "acute abdomen," with signs of complete obstruction. At this point death may occur if the volvulus is not reduced. In their second paper the authors present 9 cases of idiopathic gastric volvulus, 6 organo-axial and 3 mesentero-axial.

Gastric volvulus secondary to other conditions, discussed in the third paper of the series, is illustrated by 12 case reports. The associated conditions included eventration of the diaphragm, diaphragmatic hernia, duodenal ulcer, marginal ulcer and postoperative adhesions, colonic diverticulitis, and pancreatic neoplasm.

It is often difficult to differentiate the organo-axial type of volvulus from a cascade stomach. The following features are important in the differential diagnosis:

(1) There is one fluid level in cascade stomach; two in volvulus.

(2) The greater curvature is uppermost in volvulus; not in cascade stomach.

(3) In volvulus the uppermost rotated greater curvature forms a convex curve continuous with the duodenum, simulating an apparently enlarged sweep of the duodenum.

(4) The entrance of the esophagus in cascade stomach is in its normal position just below the diaphragm. In volvulus the entrance of the esophagus is unusually low.

Sixty-two roentgenograms; 3 drawings.

J. P. CHAMPION, M.D.
Grand Rapids, Mich.

Cystic Dilatation of Brunner's Glands. Irvin M. Becker. Gastroenterology **27:** 455–461, October 1954.

A case is reported in which cystic dilatation of Brunner's glands, proved histologically, was manifested roentgenographically by constant ovoid radiolucent defects in the first portion of the duodenum. This rare disease is to be differentiated from duodenitis, in which condition the duodenal defects may be varied in form by palpation and there is associated duodenal irritability. Polyps are differentiated by the demonstration of pedicles and the association with gastric or intestinal polyposis and achlorhydria. Hypertrophy of Brunner's glands is indistinguishable roentgenographically from cystic dilatation and may be a stage of the same disease.

Concomitant symptoms in this and other cases were functional in nature. Treatment is medical.

Four roentgenograms; 1 photomicrograph; 1 table.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

The Administration of Barium Orally in Acute Obstruction: Advantages and Risks. J. Frimann-Dahl. Acta radiol. **42:** 285–295, October 1954.

The author believes that a roentgen examination with barium sulfate given by mouth is indicated in all doubtful cases of small bowel obstruction. It is important to decide from routine films whether the obstruction is situated in the small or large intestine. If a large bowel obstruction is most likely, the approach to a definite diagnosis is a barium enema. In doubtful cases, also, a barium enema should be administered first, followed by small bowel examination if the colon appears to be normal.

The advantages of this method of examination are enumerated, and the following points are made. (1) In the presence of uncertain signs of ileus, a definite diagnosis can be established. It is also possible to make a diagnosis of volvulus of the small intestine. (2) Repeated roentgen examinations may be useful in making a definite diagnosis. This is particularly true of early cases. (3) It may be determined whether obstruction is complete or incomplete. In the presence of complete obstruction, surgery is generally indicated. In most cases of partial obstruction the passage is re-established spontaneously and no special treatment is needed. (4) Acute abdominal conditions giving initial findings which may be confused with mechanical obstruction are acute appendicitis, salpingitis, pancreatitis, cholecystitis, and regional enteritis. (5) With the use of this examination, the mortality rate in acute obstruction has gradually decreased over the years. Many factors have played a part, but the diagnostic problems are the most decisive. (6) In many instances barium may be administered by mouth postoperatively when a condition of ileus is suspected.

The possible disadvantages of oral barium administration are: (1) The observation period is prolonged. (2) One may run the risk of encountering cases of perforated ulcers, mistaken for obstruction. (3) Retention of barium in the large bowel in the postoperative period may occur. To obviate this latter difficulty the author recommends that a small amount of barium sulfate be used. The method is contraindicated when a definite diagnosis of obstruction has been made clinically and by routine roentgen studies and when there are definite roentgen signs of an advanced condition, especially the presence of fluid or gas in the peritoneal cavity.

Fifteen roentgenograms 2 tables.

HOWARD L. STEINBACH, M.D.
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Intussusception. Ira S. Goldenberg. Surgery **36:** 732–739, October 1954.

From 1942 through 1953 inclusive, 37 cases of intussusception were seen in 34 patients on the University Surgical Service of the Grace-New Haven (Conn.) Community Hospital. Sixty per cent of the patients were males. All but 4 patients were children under five years of age; 73 per cent of this number were less than two. Twenty-two patients had symptoms of less than twenty-four hours duration before being seen by the hospital staff; 60 per cent of these had had symptoms less than twelve hours. Thirty-one patients had abdominal pain, 30 vomiting, 26 an abdominal mass, and 19 rectal bleeding. An elevation of temperature greater than 1° F. was present in 21 of the cases,

and a leukocytosis with a shift to the left occurred in 27.

Survey roentgenograms of the abdomen were interpreted as showing small bowel obstruction in 16 patients, suggesting intussusception in 13 of these. A barium enema study followed the survey films, and an intussusceptive defect was demonstrated in each instance. Spontaneous reduction of a probable intussusception occurred in 2 patients, and in each a barium enema examination performed after reduction had evidently taken place was interpreted as normal. Complete reduction of the intussusception was accomplished by only 40 per cent of the barium enemas given. Partial reduction took place in 21 per cent; reduction at operation was accomplished in these cases. Two children were not explored because of probable spontaneous reduction. Twenty patients had ileocecocolic intussusception, 9 ileocecal, 4 ileoileocecocolic, 1 jejunojejunal, and 1 ileoileal.

Only one death occurred in this series, in a 2-year-old boy who had had symptoms for forty-eight hours before admission; postmortem examination revealed ileocecocolic intussusception, with strangulation and gangrene of the intussuscepted portion of ileum.

Six roentgenograms; 3 tables.

Reduction of Intussusception by Barium Enema. Mark M. Ravitch. Surg., Gynec. & Obst. **99**: 431–435, October 1954.

The author is an advocate of hydrostatic pressure reduction of intussusception by barium enema in infants and children. When the diagnosis is suspected, the child is taken to the fluoroscopic room and a Foley bag catheter with a 45-c.c. balloon is inserted in the rectum and the balloon distended. The catheter should be ungreased so that it may be less readily expelled, and the buttocks should be firmly strapped together with adhesive tape. If the child is in shock or dehydrated, blood or intravenous fluids are administered. In most cases the stomach is aspirated to avoid vomiting in the dark room. The reservoir, filled with an ordinary suspension of barium, is elevated 3 feet above the table, and the barium permitted to run into the bowel under fluoroscopic observation. This usually occurs fairly rapidly, until the head of the column meets the point of intussusception, where the advancing barium shadow becomes concave. As the pressure increases, the intussusception is pushed back. There may be intermittent changes in the appearance of the barium shadow until the intussusception is reduced to the cecum and through the ileocecal valve. The examination should not be discontinued until the barium flows freely into the ileum.

As long as reduction proceeds, however stubbornly and slowly, the treatment should be persisted in. If the child should expel the barium around the tube, the entire process is repeated with greater care to avoid leakage. At the completion of the reduction, powdered charcoal is put into the patient's stomach, and six hours latter an enema is administered to recover the charcoal and to prove beyond a doubt the completeness of the reduction.

The author believes that, with the amount of pressure utilized by maintaining the reservoir at a 3-foot level, there is no danger of perforation. He has used hydrostatic pressure reduction by barium enema as the method of primary treatment in 65 cases. In 50 cases (77 per cent) no further treatment was required. In 15 cases a small persistent intussusception at the ileocecal valve or cecum was reduced operatively. There were no deaths. In 19 (90 per cent) of the last 21 cases, reduction was accomplished by barium enema alone.

Six roentgenograms.

MORTIMER R. CAMIEL, M.D.
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Indications for X-Ray Examination of the Intestinal Tract in Patients with Pulmonary Tuberculosis. H. Erdmann. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 468–474, October 1954. (In German)

The author urges examination of the intestinal tract in patients with pulmonary tuberculosis who have intestinal symptoms regardless of whether the process in the lung is minimal or advanced, and in patients with pulmonary tuberculosis without recent gastrointestinal symptoms when the history points to a previous peritonitis or an inadequately explained appendectomy. An active tuberculous infection of the intestines should also be considered when new pulmonary foci appear many years after an apparently healed tuberculosis of the intestinal tract.

If intestinal tract tuberculosis is diagnosed at an early stage, a surgical cure may be possible. Successful surgery in the presence of advanced pulmonary tuberculosis, however, cannot be expected.

Four roentgenograms.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Difficulties of Diagnosis of Some Lesions of Colon. Frederick A. Coller and William J. Regan. Arch. Surg. **69**: 516–524, October 1954.

The authors present concisely a series of case reports with illustrations representing neoplastic and non-neoplastic lesions of the colon demonstrated by means of the barium enema. They emphasize the fact that in most instances a neoplasm has a characteristic appearance as distinguished from inflammatory disease. However, the two may look alike or may be present at the same time.

Lesions of the cecum are represented by (1) regional ileitis, (2) ileocecal tuberculosis, (3) carcinoma. Inflammatory lesions tend to involve the entire cecum, with extension to the terminal portion of the ileum, while carcinoma usually spares the cecal tip and rarely involves the ileum.

Neoplasms of the transverse colon are generally annular, with over-hanging edges. A case of localized amebic colitis of the transverse colon simulating carcinoma is illustrated.

Other cases presented include endometriosis with narrowing and displacement of the sigmoid colon by a pelvic mass; a colloid carcinoma of the rectosigmoid in a girl of seventeen, suggesting an inflammatory lesion; a case of irradiation colitis associated with carcinoma of the cervix; carcinoma of the rectum; polyposis and pseudopolyposis of the colon.

In conclusion the authors stress the importance of close cooperation of surgeon, radiologist, and pathologist.

[This paper makes good reading and is an excellent though brief review of an important and practical subject.—W.S.]

Fifteen roentgenograms.

WILLIAM SNOW, M.D.
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Calcification in Carcinoma of the Rectum. A. J. Sangster. J. Fac. Radiologists **6**: 139–141, October 1954.

This is a case report, believed to be the first in the literature, of calcification in the primary site of a rectal carcinoma. The calcification was observed on films made for routine pelvimetry at thirty-six weeks gestation. Symptoms suggested a slow-growing lesion which was probably present throughout this gestation period. At resection the lesion proved to be malignant and the presence of calcium was verified. Recurrence of the tumor did not show radiographic evidence of calcification.

Two roentgenograms; 1 photograph.

NEIL E. CROW, M.D.
University of Arkansas

Dysphagia in Carcinoma of the Pancreas. L. Langton and J. W. Laws. J. Fac. Radiologists **6**: 134–138, October 1954.

The authors emphasize that dysphagia may be one of the earliest symptoms of carcinoma of the pancreas, even though it indicates the presence of metastasis. They report 3 cases of pancreatic carcinoma with spread to the posterior mediastinal nodes and to the paracardiac nodes and nodes about the esophageal hiatus. One case showed only an extrinsic mass impression and displacement of the lower third of the esophagus while the other 2 cases showed changes similar to achalasia of the cardia, with almost complete obstruction of the esophagus and dilatation above this level.

Five roentgenograms.

J. R. MORRISON, M.D.
University of Arkansas

The Roentgen Diagnosis of Gallbladder and Biliary Tract Disease without Cholecystography. Robert L. Scanlan and Barton R. Young. Am. J. Roentgenol. **72**: 639–643, October 1954.

Much valuable information concerning gallbladder and biliary tract disease may be obtained from conventional films without the aid of cholecystography. Not only may it be possible to diagnose cholelithiasis, but the spatial relationship of the stones to the surrounding structures, to each other, and their range of movement permit rather accurate inferences to be made concerning their anatomic location and the size of the involved structure as compared with the normal.

The location of the stones with reference to the neighboring structures usually makes it possible to determine whether they are in the gallbladder or cystic or common duct. Wide separation of the stones, or a considerable shift of their location when multiple exposures are made in different positions, is indicative of dilatation of the gallbladder. Closely packed, faceted stones are suggestive of a normally sized or contracted gallbladder. Lack of shift of a calculus situated in the region of the neck of the gallbladder is indicative of impaction or cystic duct stone.

Milk of calcium bile or calcification in the gallbladder wall is directly demonstrated by shadows of calcific density, the shapes of which identify the location of the deposits.

Air in the biliary system may be due to (1) erosion of stones into the intestinal tract and (2) surgical anastomosis of the gallbladder or common duct to the gastrointestinal tract. Less commonly air may enter the biliary tract following (1) the perforation of an ulcer, incompetence of the ampulla of Vater due to carcinoma of the pancreas, pancreatitis, or recent passage of a common duct stone. Occasionally barium may enter the fistulous tract or regurgitate into the common duct through an incompetent sphincter during a gastrointestinal study.

Gas-producing organisms may gain entrance into the biliary tract. The gas first appears in the lumen of the gallbladder, next in the gallbladder wall, and finally in the pericholecystic tissues; not in the biliary ducts first, as happens in biliary-intestinal fistula.

Visualization of the gallbladder without the aid of cholecystography is usually indicative of gallbladder disease, although occasionally the outline of a normal gallbladder will be seen. It is usually enlarged but it may be contracted. A differential diagnosis from surrounding tumefactions must be made and this may require additional diagnostic procedures. Indentation of the barium-filled intestine must not be accepted as evidence of an enlarged gallbladder unless associated corroborative findings are present.

The possibility of diagnostic errors is recognized by the authors and the necessity of differential diagnosis is emphasized throughout the article. The superiority of prone, supine, and lateral decubitus films over any single projection in the roentgen diagnosis of gallbladder and biliary tract disease is stressed.

[This is an ably, concisely written article dealing with a subject of major medical interest. The authors are to be congratulated.—H.C.J.]

Ten roentgenograms.

H. C. JONES, M.D.
Grand Rapids, Mich.

A Comparison of Five Gallbladder Media. E. E. Seedorf, W. N. Powell, and D. N. Dysart. South. M. J. **47**: 809–813, September 1954.

The results obtained with five media for demonstration of the gallbladder are compared. The authors' conclusions are as follows: Sodium tetraiodophenolphthalein produces good quality cholecystograms providing a high diagnostic accuracy. Objections to its use are its unpalatability and the high incidence of nausea and diarrhea. Priodax, Monophen, Telepaque, and Teridax are equally well tolerated and produce the same relative incidence of side-reactions. These reactions are not sufficiently objectionable to contraindicate use of the media. About 15 per cent of the authors' patients tested showed evidence of pseudoalbuminuria, often persisting for several days following ingestion of the contrast material. It would be helpful to know if other laboratory tests might be rendered similarly inaccurate.

On the basis of their own experience and information in the literature, the authors conclude that employment of any of the available cholecystographic media enables one to achieve a high degree of diagnostic accuracy.

Five roentgenograms; 4 tables.

The Place of the Intravenous Cholecystogram in the Diagnosis of Acute Cholecystitis. Rudolph M. Gonzalez, Eugene F. McGrade, and Jack A. Cannon. West. J. Surg. **62**: 423–427, August 1954.

If early surgery is indicated in acute cholecystitis, then early accurate diagnosis is essential. Considerable difficulty is encountered, however, in the per-

formance of a gallbladder study by the oral administration of a contrast agent, especially in the presence of vomiting or inability to absorb the medium. The authors, therefore, report a series of 56 cases in which intravenous cholecystography was performed. Although the intravenous administration of contrast medium has been held to be contraindicated because of the incidence of untoward reactions, they used a solution of tetraiodophenolphthalein and observed only one mild reaction, with prompt recovery without treatment.

In 10 of the 56 cases, the gallbladder was found to be normal, excluding a diagnosis of cholecystitis; in the remaining 46 the findings indicated a diseased gallbladder, and this was subsequently confirmed at operation. In the 10 patients in whom the cholecystograms were reported as normal, an eventual diagnosis of peptic ulcer was made in 3, of acute appendicitis in 2, pyelitis in 1, and gastroenteritis in 4.

The authors do not recommend the routine use of the intravenous cholecystogram, since the safety, efficacy, and convenience of oral cholecystography in the diagnosis of chronic gallbladder disease are obvious. However, in patients suffering from acute abdominal conditions and facing possible operation, the value of intravenous cholecystography appears established. The dangers of reaction can be minimized by slow administration of a dilute solution of the medium.

Three tables. FRANK T. MORAN, M.D.
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Intravenous Cholangiography. Frank Glenn, John Evans, Malcolm Hill, and John McClenahan. Ann. Surg. **140:** 600–612, October 1954.

A promising new agent, Cholografin, introduced in Germany as Biligrafin (See Absts. in Radiology **62:** 903–905, 1954), which has consistently outlined the common bile duct after cholecystectomy, is the subject of this report. The authors have administered it 88 times to 80 patients, with few adverse effects.

In Cholografin the iodine, which comprises 64.32 per cent of the mass of the molecule, remains firmly bound to it through the entire process of excretion. The properties of high iodine concentration, stability, and rapid excretion by the liver, make this an effective agent for delineating the biliary tract. In the normal subject 90 per cent of the compound is excreted by the liver and 10 per cent by the kidneys within 90 minutes after injection. In 20 per cent solution the substance is almost perfectly isotonic and causes little local reaction at the site of injection. Forty cubic centimeters of the 20 per cent solution is the usual dose. The only contraindications to the use of this medium are idiosyncrasy to iodine, hyperthyroidism, and chronic progressive liver disease.

Patients are tested with a subcutaneous injection of 2 minims of Cholografin. If after fifteen or twenty minutes there is no reaction, the intravenous injection is given. With the patient prone and the right side elevated 30 degrees from the table top, radiographs are made in the postero-anterior projection, with the following factors: 65 kv, 300 ma, 1/5-second, 40-inch target-film distance, Potter-Bucky diaphragm. The first roentgenogram is made fifteen minutes after the injection is finished, and another five minutes later. Both films are developed and subsequent radiographs are obtained as indicated. The common bile duct is usually visible ten to sixty minutes after injection. A normal gallbladder begins to opacify in about fifty minutes.

The length of time the biliary tract may be visualized is prolonged to some extent by inducing spasm of the sphincter of Oddi with morphine or paregoric before injecting the medium.

The only evidence of toxicity in the authors' series was transient nausea and flushing, which were promptly relieved by deep breathing and slowing the rate of injection.

In the entire series of 80 patients the common duct was demonstrated 53 times. It was never recognized in the presence of jaundice, but was shown in 4 out of 8 individuals without jaundice but with laboratory evidence of liver damage. Cholecystectomy had been previously performed in 30 of the group. Among these the common duct was shown in 24.

For routine cholecystography, Cholografin has no advantages over conventional oral preparations, but should be reserved for the following situations: (1) the post-cholecystectomy syndrome, in which the method proved of great value in demonstrating common duct stone and residual duct stumps; (2) for preoperative cholangiography, to demonstrate calculi in the common duct before cholecystectomy; (3) when oral cholecystography fails or is not feasible; (4) in children; (5) in emergencies, when the factor of speed is of distinct advantage; (6) when tumor is suspected near the porta hepatis.

Body-section radiography was used in some cases to show more clearly the opacified common duct. A barium meal may be given, and the relationship of the duodenum and common duct established when there is reason to suspect a lesion in or near the ampulla of Vater.

Fourteen roentgenograms; 14 drawings; 8 tables.
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Shreveport, La.

Visualization of the Biliary Tract by Means of Biligrafin, Especially After Cholecystectomy. Werner Teschendorf. Am. J. Digest. Dis. **21:** 247–251, September 1954.

Cholangiography was carried out with Biligrafin (Cholografin) by the author in 250 cases. In 200 of these the contrast medium employed was Biligrafin forte, a 40 per cent compound of an iodolithium salt. No evidence of intolerance to the medium was encountered in the series, although a transient condition verging on shock developed in one patient. The preparation was given in 15 cases of icterus and subicterus; no ill effect was observed after the injection nor any intensification of the jaundice. The author emphasizes, however, that the time for intravenous injection of 20 c.c. of a 40 per cent solution or 40 c.c. of a 20 per cent solution must not fall short of eight minutes. After injecting half of the solution, a pause of from one to two minutes is recommended. Roentgenograms are taken preferably at ten, twenty, thirty, and forty minutes after the injection. The hepatic and common bile ducts were visualized in 98 per cent of the author's cases, and the stump of the cystic ducts in most cholecystectomized patients.

Although no aggravation of symptoms in liver insufficiency has followed the administration of Biligrafin, the author believes its use in patients with that condition is not indicated.

Eight roentgenograms.

Intravenous Cholecystography and Cholangiography: Clinical Trials with a New Medium (Biligrafin). David Sutton and John V. Tillett. Brit. J. Radiol. **27**: 575–581, October 1954.

A comparison was made of 120 unselected cases in which cholecystography was done with Biligrafin (Cholografin) given intravenously and 100 cases with orally administered Telepaque. The Biligrafin gave better results in all cases. The bile ducts were visualized in 100 per cent and the gallbladder in 92 per cent.

Ten patients with obstructive jaundice were given double doses of Biligrafin, but in only 1 was there any visualization of the biliary tract.

Twelve roentgenograms.

SYDNEY J. HAWLEY, M.D.
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Operative Cholangiography. Survey of Present Day Opinions. Carl W. Clark, Jr. Am. J. Surg. **88**: 599–601, October 1954.

A small study was carried out wherein questionnaires were sent to a group of surgeons and roentgenologists asking their opinions with respect to operative cholangiography. The responses were divided into three groups, namely, advocates, conservatives, and skeptics. An analysis revealed that a majority endorse the procedure and it is becoming increasingly popular.

Three tables.

L. A. PILLA, M.D.
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Abdominal Aortography for the Roentgen Demonstration of the Liver and Spleen. Leo G. Rigler and Paul C. Olfelt. Am. J. Roentgenol. **72**: 586–596, October 1954.

A method of opacification of both the liver and spleen by abdominal aortography is described. Forty cubic centimeters of 70 per cent Urokon is injected into the aorta well above the celiac axis. The entrance of the contrast medium into the liver is accomplished in two ways. One is by actual introduction into the hepatic artery directly from the abdominal aorta. Second, a return flow into the liver comes from the spleen, which is obviously extensively filled with contrast medium through the splenic artery and this becomes well opacified. There is also a considerable return from the remainder of the portal veins fed by the superior mesenteric. The final opacification is accomplished by reason of the fact that, during the course of passage through the hepatic and portal veins, communication with the sinusoids occurs and there is diffusion of the medium throughout the substance of the liver itself.

Serial radiographs are made with a rapid film-changing cassette, and the best opacification is usually produced eight to twelve seconds after injection. In general, the density produced in the liver is less than that of the spleen and distinctly less than in the kidneys.

Preliminary studies indicate that in cirrhosis of the liver opacification is delayed and may not occur at all. A case of cystic disease of the liver is presented in which the cysts appear as radiolucent defects in the otherwise homogeneously opaque liver. The procedure is of value in determining the presence and extent of tumors in the liver. In the authors' experience, metastatic foci have presented as avascular areas in the liver in contrast to the "staining" phenomenon classically described in the kidney and brain. On the other hand, some cases of metastatic nodules in the liver were not identified, presumably because their vascularity was not sufficiently different from the remaining liver. Additional value of the procedure may be the determination of intra- or extrahepatic localization of palpable tumors.

Fifteen roentgenograms.

GEORGE E. LERNER, M.D.
Cleveland City Hospital

HERNIA

The Value of the Routine Chest X-ray Film in Detecting Diaphragmatic Hernia. A Report of 53 Cases. Abel Froman. Dis. of Chest **26**: 457–463, October 1954.

The author stresses the value of the routine chest roentgenogram in the detection of diaphragmatic hernia. One or more of the following observations should suggest the possibility:

(1) Absence of a gas bubble or *Magenblase*, below the diaphragm. In reducible hernias the stomach gas bubble may become apparent at times in the erect position.

(2) An enlarged square or globular cardiac silhouette. The enlargement is usually to the left but may also extend to the right. Within the cardiac silhouette there may be visualized a large air pocket with or without a fluid level, or streaks of air may be apparent along the borders of the ventricles.

(3) An ovoid, elongated area of homogeneous density within the lowermost portion of the center of the cardiac silhouette. This does not contain air or fluid levels, merges broadly with the subdiaphragmatic shadow, and does not alter the shape of the heart.

(4) A massive density occupying the lower portion of the lung field, obscuring the diaphragm and merging with the subdiaphragmatic shadow. This density may be homogeneous or contain air pockets.

Barium studies are indicated to confirm suspicious findings.

During a three-year period, 80,000 routine chest roentgenograms were made on resident patients, new admissions, and employees of the Manteno State Hospital (Illinois). This represented 17,076 persons. Fifty-three unsuspected hernias were discovered.

Ten roentgenograms.

HENRY K. TAYLOR, M.D.
New York, N. Y.

THE MUSCULOSKELETAL SYSTEM

Dysphagia of Transitory Type Produced by Hypertrophic Spurs on Cervical Vertebrae. Hugh Stephens and William L. Janus. Ann. Int. Med. **41**: 823–828, October 1954.

The authors present 2 cases of apparently functional dysphagia associated with indentation of the posterior wall of the esophagus by protruding spurs arising from the anterior vertebral margins in the cervical spine. Both patients were described as of the anxious, phobic type. The authors assume that this posterior indentation of the esophageal wall may have been a factor in the dysphagia. However, there appears to have been no difficulty in swallowing barium and no evidence of delay is reported. Had barium capsules lodged at this level, even temporarily, the syndrome might be more convincing.

The average radiologist examines many cases for functional dysphagia, and productive lipping and spurring about the anterior cervical vertebrae are frequently seen in the older age group.

Seven roentgenograms. ALFRED O. MILLER, M.D.
Louisville, Ky.

Vertebra Plana (Calvé's Disease) Due to Eosinophilic Granuloma. Edward L. Compere, William E. Johnson, and Mark B. Coventry. J. Bone & Joint Surg. **36-A:** 969–980, October 1954.

Four cases of eosinophilic granuloma with spinal involvement are reported. Three of these presented the classical picture of vertebra plana. In 1 there was only partial vertebral collapse, and the authors postulate that the process was arrested by treatment before the findings of vertebra plana were fully developed. Two patients had lesions in one or more ribs. In each instance the diagnosis of eosinophilic granuloma was proved by biopsy.

Clinically, Calvé's disease apparently represents a syndrome occurring in young children, most commonly between the ages of four and nine years. The syndrome is characterized by back pain and associated signs of muscle spasm, tenderness, and rigidity. Roentgenographically, in the early stages, the lesion is osteolytic, with progressive disappearance of the vertebral body. Later, the vertebra appears evenly flattened from front to back, with only the denser vertebral plates remaining, giving the typical "edge view of a silver dollar" appearance.

Early treatment should include splinting and rest to prevent further vertebral collapse. Addition of roentgen therapy to this classical régime shortens the symptomatic period and hastens osseous healing. Irradiation was utilized in all 4 of the authors' cases.

Nineteen roentgenograms; 2 photomicrographs; 2 photographs. RICHARD E. OTTOMAN, M.D.
University of California, L. A.

Whip-Lash Injury of the Lumbar Neural Arch. Henry Milch. Bull. Hosp. Joint Dis. **15:** 163–168, October 1954.

During the past several years, the clinical picture of "whip-lash" injuries to the cervical spine has been brought to the attention of the medical and, more prominently, the legal profession. Little, if any, attention has been given, however, to the possible occurrence of similar lesions in the lumbar spine.

The author reports a case of "whip-lash" injury to the fourth and fifth lumbar vertebrae. The patient complained of pain in the mid-dorsal and lumbar regions, but motion in the lumbar spine was completely normal both in the anteroposterior and lateral directions; motor power, reflex response, and sensory perception in the lower extremities were normal, and a roentgenogram of the cervical and dorsal spine revealed no evidence of bony abnormality. The patient continued to complain of pain in the lumbar spine, and about five weeks after the injury roentgenograms showed that the spinous processes of both the fourth and fifth lumbar vertebrae had been fractured.

This case emphasizes the necessity of early and repeated roentgenographic study even in what may appear to be clinically insignificant injuries. While the failure to obtain such data may or may not be of importance in the clinical course of the injury, it is invariably of determining consequence from a medicolegal point of view. A second case is presented to illustrate this.

Three roentgenograms.

Congenital Dysplasia of the Hip. Observations on the "Normal" Joint in Cases of Unilateral Disease. S. L. Weissman. J. Bone & Joint Surg. **36-B:** 385–396, August 1954.

The author reports a series of 51 infants with unilateral congenital dysplasia of the hip, all of whom had abduction-contracture of the opposite "normal" hip.

The clinical and radiologic findings referable to the dysplastic hip were typical of others described. The flexed and abducted attitude of the "normal" hip, present in all the infants, was best observed when the child assumed his favorite natural position. The abduction of the hip was found to be due to contracture of the hip abductor muscles. Any attempt at passive adduction of the "normal" leg either increased the existing pelvic tilt or, when this was prevented by fixation, failed to bring the leg closer to the mid-line. The evolution of the abduction contracture was toward spontaneous regression.

The coexistence of unilateral dysplasia and of an abduction-contracture in the opposite hip strongly suggests an etiologic relationship, and it is the author's opinion that the contracture deformity leads to dysplasia of the opposite side. Whether this etiologic relationship is proved by statistics or not, it seems at least that the discovery of unilateral abduction-contracture soon after birth should be a warning that dysplasia may develop in the opposite hip, and both deformities should be watched for during early months of life.

Fourteen roentgenograms; 4 photographs; 1 chart; 2 tables. RICHARD A. ELMER, M.D.
Atlanta, Ga.

Slipping of Upper Femoral Epiphysis. Epiphysiolysis, Epiphysiolisthesis, Epiphyseal Separation or Fracture, Epiphyseal Coxa Vara. Carl E. Mosse. Arch. Pediat. **71:** 305–312, October 1954.

The author discusses the theories regarding the etiology of slipping of the upper femoral epiphysis and presents a case with rather typical findings. Although the diagnosis may be strongly suggested by the physical findings and the history, it can be confirmed only by x-ray examination. The first roentgenographic signs are widening and irregularity of the epiphyseal line with decalcification of the proximal end of the neck. This is sometimes referred to as the "preslipping" stage, although usually a minimal degree of slipping can be demonstrated by suitable radiographic technic. The degree of slipping is best measured by comparison with the other hip. In the later phases of slipping, the neck is shorter and broader on the involved side.

Treatment varies with the degree of slipping present. Early diagnosis is of great importance in obtaining a good final functional result.

Two roentgenograms. DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Avascular Necrosis of the Phalanges of the Hands (Thiemann's Disease). Ernest W. Shaw. J.A.M.A. **156:** 711–713, Oct. 16, 1954.

Thiemann's disease is an avascular necrosis generally

affecting the proximal interphalangeal joints of the middle fingers, though the second, third, fourth, and occasionally the fifth fingers have been affected. The lesions attack both hands but not always the same joints. The disease has been associated with similar lesions in the great toe and in the first tarsometatarsal joint. It has been noted only in late childhood and during adolescence. Fusiform swelling of the proximal interphalangeal joint occurs and is associated with some restriction of movement. No skin changes are present, as a rule.

Thiemann's disease is differentiated from rheumatoid arthritis by the absence of redness and heat in the involved joints and by freedom from systemic symptoms. It differs from osteoarthritis in the joints involved and the early age of onset. The clinical course, history, physical examination, and roentgen and laboratory studies help to distinguish the condition from the infectious arthritides and from the known metabolic and endocrine disorders.

The pathogenesis of aseptic osseous necrosis is now understood, though the cause remains unknown. One of the principal types is an osteochondritis of growing epiphyses. Histologically the involved epiphyses are compressed and split, especially in their central portions. As a result of the absorption of bony fragments, irregular defects occur that may assume such proportions that only a small fraction of the margin and irregular islets of bone in the center remain intact within the bony epiphyses. The epiphysis and metaphysis are widened. The phalanx is retarded in growth. The joint space is not narrowed but may be irregular; the joint capsule is moderately thickened. Toward the end of puberty the epiphysis regenerates and, at the normal time, joins with the metaphysis. The end-result is a moderate thickening of the epiphysis and metaphysis and a slight shortening of the phalanx. There is a dominant mode of inheritance with strong penetrance.

The author reports a case in a twenty-year-old male. The family history included 4 examples of Thiemann's disease demonstrated roentgenologically and 17 "probable" cases, in six generations.

Four roentgenograms; 1 photograph; 1 diagram.

JOHN P. FOTOPOULOS, M.D.
University of Michigan

Range of Movement of the Great Toe in Men. J. Joseph. J. Bone & Joint Surg. **36-B:** 450–457, August 1954.

The author made a study of range of motion of the metatarsophalangeal and interphalangeal joints of the big toe by means of lateral radiographs in 50 males. Detailed descriptions are presented and diagrams indicate the normal angles.

Conclusions are drawn which indicate a wide variation between individuals in the amount of movement at these joints. For an adequate understanding the article must be studied in considerable detail.

Nine figures; 2 tables.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

Skeletal Involvement in Carcinoma of the Urinary Bladder. Denis E. Fletcher. J. Fac. Radiologists **6:** 109–119, October 1954.

Four hundred and twenty-seven patients with carcinoma of the urinary bladder were examined in a ten-year period (1943-1952) at Kirstey Hospital, Manchester, England. Roentgenologic evidence of skeletal involvement was found in 5 per cent of the cases, which compares favorably with the incidence reported in the literature, although naturally a higher percentage is found at autopsy.

The spread to bone may be due to: (1) direct extension of the primary tumor, (2) direct extension from metastases in the regional lymph nodes; (3) distant metastasis, probably *via* the blood stream, with the lymphatics a less likely route. The pelvic bones are most frequently involved (58 per cent). Next in frequency are the lumbar spine (18 per cent), femur (14 per cent), sacrum (12 per cent), and ribs (12 per cent). Most of the lesions are purely osteolytic (86 per cent). They appear as areas of diminished density with an ill-defined edge.

Pure osteoblastic metastases were present in a significant number of cases (9 per cent). A smaller proportion show mixed osteolytic and osteoblastic lesions. The author describes another type which he designates as "osteogenic lesions," consisting of combined destruction and periosteal new bone formation. These may be difficult to distinguish from osteogenic sarcoma, differentiating points being the older age group and absence of underlying pagetoid changes.

Although bone involvement is usually considered a late phenomenon, the author found that 37 per cent of his patients had had symptoms of less than twelve months' duration. These figures are even more significant when it is recalled that a fair portion of these symptoms may have been due initially to a benign papilloma. Eighty-five per cent of bone metastases from carcinoma of the bladder produce symptoms before they can be demonstrated radiologically. Thus, aside from routine radiographs of the pelvis, bone surveys are likely to be fruitless in the absence of pain.

H. J. BARNHARD, M.D.
University of Arkansas

GYNECOLOGY AND OBSTETRICS

Clinical Applications of Obstetric Radiology. R. L. Haas, H. B. Latourette, and W. M. Whitehouse. Surg., Gynec. & Obst. **99:** 462–468, October 1954.

It has been found at the University of Michigan Hospital that, when the obstetrician and radiologist study the obstetrical roentgenograms together, there results a mutually advantageous increase in knowledge.

Routinely three films are exposed: (1) an anteroposterior supine frontal film, 14 × 17 inches, to include the entire uterus and maternal pelvis; (2) a lateral view of the abdomen, 14 × 17 inches, obtained with a wedge filter, showing the pregnant uterus and the lumbar spine; (3) a 10 × 12-inch lateral projection of the maternal pelvis, to be used for a qualitative estimate of the anteroposterior pelvic diameters and their relations to the fetal head. For precise pelvimetry, an additional 10 × 12-inch frontal film, centered 1 inch above the pubis, is added.

The major indications for roentgen study are the following: estimation of fetal age; placental localization; evaluation of fetopelvic size relations; evaluation of the atypical pregnant abdomen; study of abnormal labor; determination of fetal position, presentation, and attitude; determination of fetal death or abnormality; confirmation of pregnancy. Routine

studies of the maternal chest and a neonatal survey of the newborn infant's chest have also been instituted. The value of the latter study has not yet been estimated. In general its most significant contribution to date is demonstration of the wide variation in the appearance of the normal chest in the newborn.

In determining fetal maturity, two ossification centers are of practical value: the distal femoral epiphyses, which usually appear about the thirty-fifth to thirty-sixth week of gestation, and the proximal tibial epiphyses, which ossify three or four weeks later. If either or both of these centers can be identified there is excellent assurance that the pregnancy has progressed to a state where chances for extra-uterine survival are good. The presence of a well developed subcutaneous fat line also indicates maturity. The placental site is indicated on the lateral view by a soft-tissue shadow of uniform density lying between the subcutaneous fat line of the fetus and the external uterine contour, which is in excess of the width of the uterine wall. This evidence of a normally situated placenta excludes the possibility of placenta previa. A displacement of the presenting part from its usual relationship to the maternal pelvic inlet is suggestive of a low-lying placenta. The persistence of abnormal presentation may be an indication of placenta previa.

The authors believe that an unwarranted amount of attention has been directed toward the precise measurement and classification of the maternal pelvis. Consequently they use x-ray pelvimetry only rarely and base their judgment as to fetopelvic relationships more on general information obtained from scrutiny of the films. They attempt to anticipate the plane of the pelvis where difficulty may be expected, and to estimate its degree of disproportion. They believe that cesarean section is only rarely justified solely on the basis of x-ray evidence of disproportion. Safe vaginal delivery requires a favorable combination of pelvic size, fetal size, fetal position, fetal head moldability, and uterine contractions.

In the determination of fetal death or abnormality, it must be remembered that an interval of one to two weeks following fetal death may be necessary before any roentgen signs become apparent. It is also important to bear in mind that these signs are generally presumptive and that a combination of two or more enhances the accuracy of diagnosis appreciably. The signs of fetal death are: (1) fetus smaller than the menstrual history would indicate; (2) lack of change of fetal position or attitude over a period of time; (3) apparent compression of the fetus with hyperflexion and sometimes acute angulation of the fetal spine; (4) persistent deviation of fetal attitude from the normal one of flexion, commonly seen in association with hydramnios; (5) overriding of the skull bones; (6) relative decrease in density of fetal bones.

Radiographic detection of pregnancy depends upon the presence of sufficient calcification of the fetal skeleton to cast a shadow on the film. This is generally possible by four and a half months of gestation. A lateral projection may reveal a fetal skeleton which has been obscured in the other views by the maternal bony structures.

As one becomes familiar with the application of radiology to obstetrics, its scope gradually increases.

Three roentgenograms; 1 table.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N.Y.

Orthostereoradiography in Obstetrics. Precision Method for Cephalopelvimetry. Teodoro Flores Covarrubias. Rev. mex. de radiol. **8**: 265–274, October-November-December 1954. (In Spanish).

The author reviews the Moloy technic of pelvimetry, presenting it as a precise and rapid method for evaluation of cephalopelvic proportion. Anteroposterior stereoscopic views of the pelvis are made with the patient in a supine position and the lumbar lordosis slightly accentuated by means of a cushion. Right and left stereoscopic views are made, with a perforated metal rule in the mid-perineal region.

The films are studied in stereo, and a good tridimensional view of the pelvis is thus obtained. The different diameters of the pelvis and the fetal head are measured by means of the rule that appears on the film. Classification of the pelvis can be made according to the configuration given by a series of disks that are superimposed on the anteroposterior projection in the true conjugate diameter. These disks are made of cardboard with a handle of wood and are of different diameters, ranging from 8 to 13 cm., with progressive differentials of 0.25 cm. The type of pelvis is determined in this procedure by the shape and amount of the square area that is located outside of the superimposed disk. The greatest anteroposterior and lateral diameters of the fetal head are measured with the rule in order to obtain the average diameter.

Using the stereoscopic procedure, radiological distortion is reduced to a minimum and measurements can be made with the ruler or with the graduated disks. The absolute volume of the pelvis and fetal head can be determined with the polar planimeter and the curvimeter. Obstetrical prognosis is thus facilitated.

It is to be noted that the use of this method requires an expensive and complicated equipment that is available only in large radiological centers.

Seven figures, including 1 roentgenogram.

GUILLERMO TRIANA, M.D.
St. Vincent's Hospital, N.Y.

The Ovarian Artery. An Arteriographic Study in Human Subjects. Ulf Borell and Ingmar Fernström. Acta radiol. **42**: 253–265, October 1954.

An investigation was carried out to ascertain the percentage of cases in which visualization of the ovarian artery can be achieved by aortography and whether its radiologic demonstration opens up new diagnostic possibilities with special reference to the diagnosis of adnexal tumors. The aortograms of 77 women were studied. Fifty-nine of the group were of reproductive age, and 18 were at the menopause or postmenopausal.

The ovarian artery was seen in 22 cases. Its course was found to be quite characteristic. This was generally straight or slightly wavy for a short distance, becoming markedly tortuous on reaching the pelvic inlet. In 10 of the 16 cases examined by aortography with aortic compression, the ovarian artery could be seen. Of the 61 cases examined by aortography without aortic compression, visualization of the ovarian artery was obtained in 12. As it was found that aortography with aortic compression can interfere with renal function, this method was abandoned.

The radiologic demonstration of the ovarian artery was of diagnostic value in 2 cases. In one of these the ovarian arcade was found to be markedly stretched out. This patient had a cyst in the left ovary. In the other case, one of right tubal pregnancy, filling of the

placental sinuses was obtained by way of the ovarian artery.

Six roentgenograms; 5 drawings.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

THE GENITOURINARY SYSTEM

Renal Anomalies. A Source of Confusion in Diagnosis of Abdominal Disease. T. Burton Smith. West. J. Surg. **62:** 519–524, October 1954.

The author discusses a number of renal anomalies that are frequently encountered in the examination of patients for abdominal disease. Ectopia or malascent of the kidney, he states, accounts for about one-sixth of all renal anomalies. The reported incidence varies between 1 in 500 to 1 in 1,500 autopsies, and between 1 in 250 to 1 in 500 clinical patients. Horseshoe kidney is found about as frequently, between 1 in 345 and 1 in 1,100 autopsies. Congenital stricture of the ureteropelvic junction is the commonest form of anomaly, being observed in 14 per cent of routine urograms. The constrictions are due in most instances to congenital intrinsic stenoses, less frequently to combined intrinsic and extrinsic obstruction or to vessels and fibrous bands alone.

The outstanding symptom in the author's series [not otherwise defined] was pain. The next most common symptom leading to the diagnosis of a renal anomaly was an abdominal mass accidently discovered by the surgeon or by the patient. In all cases the diagnosis is dependent upon x-ray examination, particularly intravenous urograms. Some cases require, also, cystoscopic examination, differential renal function tests, differential urinary studies, retrograde pyeloureterograms, retroperitoneal air studies, and aortography.

The author makes a plea for the consideration of renal anomalies in the differential diagnosis of abdominal conditions, so that delay in arriving at a correct diagnosis and unnecessary treatment may both be avoided. He warns that when an ectopic kidney is found accidentally at laparotomy it never should be removed unless the status of the opposite kidney is well established (by urography, not by palpation).

Seven roentgenograms.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Congenital Solitary Pelvic Kidney. A Study of Its Blood Supply by Aortography. U. Borell and I. Fernström. J. Urol. **72:** 618–624, October, 1954.

A solitary pelvic kidney is very rare. Stevens (J. Urol. **37:** 610, 1937) found that the condition occurred once in approximately 22,000 autopsies. The authors report a case and compare their observations with 65 cases which they were able to find in the literature.

The patient was a girl of sixteen with absence of the vagina, uterus, and right adnexa. Fairly high up in the true pelvis just to the left of the mid-line was a palpable mass which later proved to be the ectopic kidney. A retrograde iliac arteriogram showed absence of the right uterine artery, and in its place an anomalous branch of the internal iliac artery, which supplied the lower pole of the kidney. An aortogram showed, in addition, a larger vessel arising at the bifurcation of the aorta which supplied most of the solitary kidney. No other kidney was found at laparotomy or by excretory urography.

Among the 66 cases in the literature the sex was noted in 52: 27 patients were women, 25 men. Among the men, associated anomalies of the genitalia were rarely encountered, although there were some instances of undescended testes. Among the women, anomalies of the reproductive organs were the rule, being found in at least 22 cases. These included aplasia of the vagina (17 cases), aplasia of the uterus (9), absence of a fallopian tube (13), absence of an ovary (9).

The authors believe that their case report is the only one to describe the blood supply of the misplaced kidney from *in vivo* investigation. Nine other cases in the literature provided full descriptions from autopsy findings. There was marked variability among these cases in the sources of blood supply, but in all instances the renal arteries arose from the aorta near the bifurcation, from the common or internal iliac arteries, or from a combination of two or more of these sources.

Four roentgenograms; 1 drawing; 1 table.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Renal Arteriography. Arthur T. Evans. Am. J. Roentgenol. **72:** 574–585, October 1954.

The technic of renal arteriography *via* aortic puncture is outlined in detail. The author injects 12 c.c. of contrast medium (70 per cent Urokon, 75 per cent Neo-Iopax, or 70 per cent Diodrast) in a period of one to one and a half seconds, using a No. 18 gauge, 6-inch needle. An exposure is made just as the injection is about to be completed. The needle is then withdrawn and within four to ten seconds a second film is exposed, obtaining a nephrogram. Potential dangers of the procedure include anesthesia intolerance, vascular bleeding, iodide sensitivity, extravasation of the contrast material, injection into a smaller artery, and anuria from intravenous iodide injection in a patient with renal failure. The possibility of inserting the needle through the intervertebral cartilage and spinal canal with resultant paraplegia is discussed. In the author's series of 1,200 arteriograms, there were no fatalities, and he believes that, while the potential dangers should be appreciated, they are probably exaggerated.

Renal arteriograms are of value in distinguishing renal cysts from tumors. In a group of 50 malignant tumors, there was only one proved case in which the arteriogram was misleading. Evaluation of renal blood supply, both of the major renal vessels and the interlobular branches, may be used as an index of potential renal function. This is of particular value in cases of complete ureteral obstruction, where pyelographic studies are not possible. The presurgical evaluation of anomalous vessels is of importance, and the amount of renal parenchyma they supply may dictate the feasibility of their sacrifice

Following severe renal trauma, arteriographic visualization gives information as to the viability of all portions of the kidney. Thus it may be possible to determine if surgical intervention is necessary and if a total nephrectomy or heminephrectomy is the preferable procedure. The preoperative appreciation of the vascular supply in congenital abnormalities of the kidneys requiring surgical correction is of infinite value to the surgeon.

Nineteen roentgenograms.

GEORGE E. LERNER, M.D.
Cleveland City Hospital

Renal Tumour Not Demonstrable by Urography But Shown by Renal Angiography. F. Olov Löfgren. Acta radiol. **42**: 300–304, October 1954.

A case of a small hypernephroma not shown by urography but demonstrated by renal angiography is described to illustrate the value of this additional method in doubtful instances. The tumor was situated subcapsularly and did not deform the outline of the renal pelvis.

Three roentgenograms; 2 photographs.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

The Diagnosis of Hydronephrosis by Percutaneous Renal Puncture. H. Stephen Weens and Thomas J. Florence. J. Urol. **72**: 589–595, October 1954.

Percutaneous renal aspiration has been previously reported as a method of diagnosis and treatment of renal cysts, as a biopsy procedure, and as a means of injection of radiopaque media for the differential diagnosis of renal tumors and cysts. The authors have applied the method to the diagnosis of hydronephrosis in selected cases. They have made their injections, under local anesthesia, with the patient prone on the x-ray table. When urine is obtained, a small amount is aspirated for examination, and 35 per cent Diodrast is injected. Films are then made, and additional contrast medium is injected if indicated.

Four cases are reported in which diagnosis of hydronephrosis was made by this means. The authors emphasize that the use of the procedure should be confined to patients in whom excretory or retrograde methods fail to supply adequate information and in whom the diagnosis of hydronephrosis is strongly suspected. A definitive diagnosis of hydronephrosis cannot usually otherwise be made (without surgery) if there is complete obstruction of the ureter. Technical difficulties in ureteral catheterization provided the indications for the procedure in 3 of the authors' 4 patients. One had an extensive urethral stricture which did not allow the passage of a cystoscope. Two others had ureteral orifices which could not be located, even though general anesthesia was used in the case of an eight-year old boy, and spinal anesthesia on a forty-two-year-old male.

Six roentgenograms.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Physical, Physiological, and Hormonal Aspects of Hydronephrosis. P. G. Keates. J. Fac. Radiologists **6**: 123–133, October 1954.

In the supine position the kidney calyces are in a dependent location with respect to the kidney pelvis, and contrast medium (Diodone) tends to pool in them, often not mixing to fill the pelvis. Taking a film in the prone position will allow visualization of the dilated pelvis. An analogy is drawn between the hydronephrotic kidney and the dilated stomach of pyloric obstruction.

The fact that the rate of urine output by a kidney is increased with increase in the dose of intravenous Diodone permits a method for more rapid and complete filling of the large "dead space" formed by the dilated calyces and pelvis. It is suggested that a double dose of the contrast medium be given if hydronephrosis is known to be present, or a booster dose as soon as the condition is recognized during the pyelographic series.

The author is not content to accept the present general opinion that the primary cause of hydronephrosis of pregnancy is probably related to hormonal activity, feeling that the evidence for such an opinion is inconclusive. He cites several points in favor of obstruction as the causal mechanism: (1) In the ureteral dilatation of pregnancy the ureters are not dilated below the pelvic brim. (2) The greater frequency of dilatation of the right ureter coincides with the fact that it is easier to compress the right ureter during intravenous pyelography in a non-pregnant patient. (3) Dilatation recedes somewhat after the sixth month of gestation, corresponding to the period when the uterus is rising out of the pelvis. (4) Primiparous women tend to show greater degrees of dilatation than do multiparae, probably owing to better tone of the abdominal muscles, which would press the uterus more firmly against the pelvic brim.

Seventeen roentgenograms; 2 diagrams.

D. D. BLAKE, M.D.
University of Arkansas

Renal Changes in Paraplegia as Screened by Routine Excretory Urography. A. Estin Comarr. J. Urol. **72**: 596–605, October 1954.

The author examined the excretory urograms of 315 paraplegic patients in a Veterans Administration Hospital (Long Beach, Calif.), with a view to diagnosing upper urinary tract disease. Abnormal urograms were listed as Grade 1 if there was mild blunting or dilatation of the calyces or renal pelvis, as Grade 2 if there was moderate to marked calycectasis, pyelectasis, or retention of medium, and Grade 3 if gross hydronephrosis was present. Among the 630 kidneys examined 73 per cent were normal, 12 per cent had Grade 1 changes, 8 per cent Grade 2, and 6 per cent Grade 3.

Of the 315 patients 289 had traumatic cord lesions, of which 171 were complete and 118 incomplete. Twenty-six patients had either disease or tumor of the spinal cord; of these lesions, 7 were complete and 19 incomplete.

Renal disease was found most frequently in patients with a lumbar or D12-L1 spinal level. The author believes that in these cases there is usually damage to the conus medullaris and, therefore, a lower motor neuron type of bladder.

The degree of completeness of the spinal cord lesion in the cervical or dorsal regions appeared to exert no influence on the incidence of kidney changes. In the lower-spinal groups of patients, however, the kidney abnormalities were greater with complete than with incomplete lesions, perhaps because patients with incomplete lesions are more likely to be ambulatory.

Pathological kidney changes tended to be more frequent and more severe with the passage of time. The earliest Grade 1 condition was seen two months, the earliest Grade 2 eight months, and the earliest Grade 3 ten months after injury. There were many exceptions and inconsistencies, however. Normal kidneys were observed as late as 372 months after trauma.

The right kidney showed pathological changes more frequently than the left.

The degree of function of a cord bladder was found not necessarily to determine the future of the kidneys, as in some patients whose bladders functioned very well pathological renal changes nevertheless developed. Of 6 patients with suprapubic catheters 5 had normal kidneys and the sixth Grade 1 damage. The author be-

lieves that most patients with well functioning suprapubic cystotomies are free from frequent pyelonephritic attacks even in the presence of vesico-ureteral reflux.

Three figures; 3 tables.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Late Results of Bladder Substitution with Isolated Ileal Segments. Eugene M. Bricker, Harvey Butcher, and C. Alan McAfee. Surg., Gynec. & Obst. **99**: 469–482, October 1954.

The results of 106 bladder substitution procedures consisting of transplantation of both ureters to isolated segments of terminal ileum have been presented. The primary operation was pelvic evisceration in 81 patients and cystectomy in 16. In 8 others the procedure was done for palliation (carcinoma or fistula) and in one for neurogenic incontinence. Sixty-five patients had been followed for six to thirty-six months after operation by means of repeated intravenous pyelograms.

There were 15 deaths in this series, 5 of which were thought definitely to be attributable to the bladder substitution procedure. Of the late complications, hydronephrosis and pyelonephritis are considered to be of most significance because of their ultimate effect upon longevity. In 70 per cent of the 65 cases reported, results were considered satisfactory in that good pyelographic shadows of both kidneys were obtained and the patients were free of clinical evidence of pyelonephritis. Thirty per cent of the 65 patients had unsatisfactory results, in that they had either unsatisfactory pyelograms or clinical evidence of pyelonephritis, or both. Eighty-six per cent of the 130 renal units involved in the 65 bladder substitution procedures were either normal or showed a minimal degree of hydronephrosis six to thirty-six months after operation. In none of the patients did hyperchloremic acidosis develop.

Sixteen roentgenograms; 1 graph; 15 tables.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

PARASITOLOGY

Calcification in Loiasis. Ifor Williams. J. Fac. Radiologists **6**: 142–144, October 1954.

Loiasis is a relatively benign disease, endemic in many parts of West Africa, caused by the *Loa loa* worm, one of the three main varieties of Filariae. The salient features are the presence of adult worms beneath the skin, especially near the eye, and Calabar swellings (transient hot swellings of subcutaneous tissue thought to be local allergic reactions, most commonly seen in the arms).

The clinical diagnosis of loiasis is based on the possibility of infection, history of adult worms or Calabar swellings, intradermal and complement-fixation tests, and eosinophilia. The demonstration of the microfilariae in the peripheral blood establishes an absolute diagnosis.

The author presents 3 cases with clinical histories and findings consistent with loiasis. In all 3 patients roentgenograms of the hand demonstrated thread-like coiled or angulated shadows of calcific density in the subcutaneous soft tissues. Tiny rods and dots of calcium were all that remained in some instances. These shadows, which correspond in size to *Loa loa* (male, 3 cm. × 0.35 mm.; female, 6 cm. × 0.45 mm.) were believed by the author to represent calcified dead worms, although no histologic proof was obtained. Three calcific densities which were thicker (1 mm.) and with wider lobulations were believed to represent calcification of a fibrous capsule caused by tissue reaction to the dead worm.

Three roentgenograms.

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University of Arkansas

TECHNIC

Xeroradiography. John F. Roach and Herman E. Hilleboe. Arch. Surg. **69**: 594–596, October 1954.

Xeroradiography is a new procedure for recording roentgen images. Unlike conventional roentgenography, it uses no solutions of any sort and thereby derives its name from the Greek word *xeros*, meaning dry. It is photoelectric in nature rather than photochemical. The basic element in the process is a metallic plate coated on one surface with a thin layer of selenium, a semi-conductor. In practice, a homogeneous electric charge is sprayed on the surface of the selenium. The plate is then exposed to x-rays in the same fashion and with the same equipment one would utilize if ordinary x-ray film were to be employed. The x-rays which pass through the subject and strike the plate selectively dissipate the electric charge on the selenium. This results in the production of a latent electrostatic image. The image can be made visible by dusting the surface of the selenium with finely divided powder granules which adhere to the selenium in accordance with the pattern of electrostatic charge.

The image obtained has much the same appearance as a standard x-ray film, except that detail and contrast gradation are superior. After the image is viewed, a permanent record is made by electrostatic or adhesive transfer of the powder to a piece of paper. The plate is then cleaned by brushing, after which it is ready for re-use. The image of a shoulder is shown from a plate that had been used 2,500 times.

Three xeroradiographs; 2 photomicrographs; 3 photographs.

Other accounts of this procedure appear in Am. J. Roentgenol. **73**: 5–9, January 1955, and J.A.M.A. **157**: 899–901, March 12, 1955.

A. J. NICHOLAS, M.D.
Shreveport, La.

An Apparatus for Automatic Introduction of Radiopaque Media in Translumbar Aortography. Martin Langsam and Nathan D. Wilensky. Surgery **36**: 777–780, October 1954.

For translumbar aortography the authors make use of the technic described earlier by Wylie and McGuinness (Surg., Gynec. & Obst. **97**: 425, 1953. Abst. in Radiology **63**: 286, 1954), 50 c.c. of Urokon being injected rapidly through two needles. Because of the inability to empty both syringes simultaneously, failure to inject all of the contrast medium within ten seconds, and other difficulties, the authors have developed an apparatus which injects the radiopaque material automatically and signals the x-ray technician when to take the roentgenograms. Hydraulic pressure machines have been used previously to drive the plungers of the syringes, but the authors found these machines too cumbersome and difficult to adjust. Their apparatus depends on a motor-driven plate. It is completely automatic and can easily be adjusted to inject different quantities of contrast medium.

Production of a Transverse Tomogram and Failures in Positioning. F. Hammer. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 513–524, October 1954. (In German).

The author studied the conditions necessary for satisfactory transverse tomography. With the aid of a metallic ruler and a metallic cylinder, the following mistakes in positioning and alignment, resulting in unsatisfactory tomograms, were demonstrated: (1) The central ray includes the axis of object rotation, but excludes the axis of cassette rotation. (2) The central ray runs parallel to the line joining the axes of object and cassette rotation. (3) The central ray passes through the axis of rotation of the object, forming an angle larger than zero and being incident on the axis of rotation of the cassette. (4) The central ray intersects the line joining the axes of object and cassette rotation, (*a*) between the cassette and object or (*b*) between the tube and object. (5) The central ray goes neither through the axis of rotation of the cassette nor that of the object and forms an angle in excess of zero with the line joining the axis of rotation of the patient and that of the cassette.

The optimal angle of rotation of cassette and object during an exposure lies between 180 and 360°, according to Janker. A light-beam focusing device should follow the central ray and should not be directed to the center of the tube window.

Electrical synchronization of object and cassette movement offers simplification of the technic.

Thirteen illustrations. JULIUS HEYDEMANN, M.D.
Chicago, Ill.

RADIOTHERAPY

Liposarcoma. A Study of 105 Cases. George T. Pack and John C. Pierson. Surgery **36**: 687–712, October 1954.

During the last twenty-five years all malignant lipogenic tumors at the Memorial Cancer Center (New York) have been subjected to the group judgment and treatment of the Mixed Tumor Service. This opportunity has permitted a survey of the largest group of these sarcomas ever studied and an application of principles of treatment under uniform guidance. The 105 cases of liposarcoma constitute 14.6 per cent of all sarcomas of the soft somatic tissues, being third in frequency and exceeded in incidence only by the group of sarcomas classified as of undetermined histogenesis (35.7 per cent) and by rhabdomyosarcomas (15.3 per cent). In the present series 56.6 per cent of the patients were males and 43.4 per cent females. The lower extremity was the site of 62.7 per cent of the liposarcomas, as compared with only 24 per cent in the upper limb; 13.3 per cent involved the retroperitoneum and trunk. In only 2 instances did the liposarcoma arise in a subcutaneous lipoma.

The malignant lipogenic tumor usually starts as an inconspicuous swelling of the soft tissues, exhibiting progressive steady growth without alarming exacerbation until it reaches such proportions as to demand the attention of the patient. Pressure symptoms may ensue when the neoplasm reaches a certain size, but pain is quite rare at the onset. As a general rule, liposarcomas are firmer, less easily compressed, and more fixed to underlying tissues, notably fascia, than are their benign counterparts, the lipomas. The first evidence of a deeply situated liposarcoma may be only a uniform swelling of a leg or arm. X-ray examination with soft-tissue technic is helpful in differential diagnosis but not sufficiently accurate to ensure the benignity of the neoplasm. Deep lipomas appear as translucent lobular masses because simple fat tissue has less density than the enveloping soft tissues; the liposarcomas with more fibrous and myxomatous tissue are relatively more opaque.

The choice between radical dissection and amputation depends on innumerable factors, such as the degree of malignancy, the regional location, the fixity or mobility, the primary or recurrent status, the presence of regional and distant metastases and, also important, the experience and judgment of the operator. Although not always possible of achievement, a good rule to follow is to remove the liposarcoma without seeing or encountering it: by this is meant that the investiture of the neoplasm by muscles, fat, and fascia remains inviolate and that the line of dissection is grossly well beyond the palpable limits of the tumor in all directions. If preoperative irradiation has been given, five or six weeks is permitted to elapse in order for maximal regression to occur and the radiation reaction to subside. Even when the previously palpable liposarcoma has regressed so that it is no longer clinically apparent, wide dissection should still be carried out.

The embryonal myxoliposarcomas are known to be very radiosensitive. This may be due in part to the fine capillary blood vessels in the stroma, which are easily damaged by irradiation. Recurrent liposarcomas, although more cellular and anaplastic, are sometimes less radiosensitive because their blood supply is obtained from peripheral sources and not from one central vascular system. It is the authors' opinion that the occasional infection of the recurrent liposarcoma and its invasiveness are the factors more influential in causing these neoplasms to lose their susceptibility to irradiation. The radiosensitiveness of liposarcomas is greater than their radiocurability; for example, of 12 liposarcomas treated entirely by irradiation, only 2 (16.6 per cent) were sterilized; 1 of the patients has enjoyed a cure for more than ten years. During the earlier years, preoperative irradiation was routinely employed; subsequent analysis of these cases showed that in 60 per cent of patients a definite regression of the tumor occurred, and in 15 per cent the tumor underwent complete clinical disappearance. Microscopic foci of residual sarcoma were found, however, in the majority of surgical specimens subsequently removed. Among the long-term survivors in the present series, all but 1 had received radiotherapy, usually as an adjunct to surgery. Preoperative irradiation is never employed for liposarcomas overlying bone, as in the scalp, pretibial region, foot, and sacrum, nor for those invading bone. In numerous instances recurrent or primarily inoperable liposarcomas have been made technically resectable by preliminary irradiation, as for example, bulky retroperitoneal tumors of this type. Postoperative irradiation is indicated in every case in which the resected tumor is recurrent. The metastases are usually responsive to x-ray therapy, particularly the multiple subcutaneous spherical deposits which are soft, ecchymotic, and very rapidly growing.

Of the total cases, primary and recurrent, operable and inoperable, under the authors' care since 1928, 67.7 per cent were suitable for surgical resection, *i.e.*, operable. Of these, 26.7 per cent were "primary operable" and 33.3 per cent were "recurrent operable." In the period from 1944 to 1948, inclusive, the operability rose to 83.3 per cent of all cases, 23.3 per cent primary and 60 per cent recurrent operable. Liposarcomas suitable for palliative treatment, *i.e.*, inoperable, decreased from 45 per cent (1928 to 1933) to 16.7 per cent (1944 to 1948). The greatest number of inoperable liposarcomas occurred in the thigh.

Ninety-one of the 105 cases of liposarcoma were suitable for analysis. Twenty-seven of these were treated within the past five years. Of the 64 patients treated more than five years ago, 2 are now living with recurrent sarcoma, 39 are dead of liposarcoma (failures), and 23 are living and well. Eight of these patients have remained well for more than ten years. Liposarcomas treated by local excision and postoperative irradiation had a five-year cure rate of 87.5 per cent because of the very early and favorable stage of their growth. Radical surgical dissection resulted in 66.7 per cent five-year survival without recurrence, which is better than the cure rate following amputation (33.3 per cent), since in past years amputation has been reserved for the very advanced cases.

Fourteen figures; 7 tables.

Collective Review. Primary Retroperitoneal Tumors: A Study of 120 Cases. George T. Pack and Edward J. Tabah. Internat. Abst. Surg. (in Surg., Gynec. & Obst.) **99**: 209–231, September; 313–341, October 1954.

This comprehensive review of retroperitoneal tumors is based on 120 verified cases seen at Memorial Cancer Center (New York) over a twenty-six-year period, 1926–51, the largest single group to be reported from any institution. This number represents about 0.2 per cent of all tumor cases seen at the Center in that time. The paper includes sections on both roentgen diagnosis and radiotherapy, and only these will be covered, briefly, in the present abstract.

Roentgen studies of the genitourinary and gastrointestinal tracts are important means of diagnosing retroperitoneal tumors. The retrograde or intravenous pyelogram is the most valuable of all the roentgen procedures in demonstrating pressure, distortion, or displacement of the kidneys, ureters, or bladder by a mass in the retroperitoneum, while an upper gastrointestinal series or barium enema study will serve a similar purpose in relation to the digestive tract. An ordinary flat film of the abdomen may be of value as an initial step, showing alteration in size, shape, and position of the renal shadow or obliteration of the psoas shadow. Special radiographic procedures include pneumoperitoneum and pneumoretroperitoneum and abdominal aortography and venography. Chest films may show elevation of the diaphragm. In 60.5 per cent of the authors' series a positive diagnosis of a retroperitoneal mass was obtained by roentgenologic means alone.

The best prospect of cure in retroperitoneal tumors lies in early detection and complete extirpation by an experienced surgical team. Since few cases are actually handled so favorably, the palliative benefits of roentgen therapy become important. Gratifying returns in pain relief, mass shrinkage, and increased longevity are often obtained. The authors recommend irradiation (1) for inoperable retroperitoneal tumors; (2) for recurrences; (3) for residually adherent or infiltrative tumors; (4) for radiosensitive tumors such as Hodgkin's disease and lymphosarcoma; (5) as an adjuvant to surgery for malignant neoplasms such as neuroblastomas, embryonal rhabdomyosarcomas, and all other undifferentiated and anaplastic sarcomas.

Six roentgenograms; 6 photographs; 1 photomicrograph; 1 drawing; 4 tables.

MORTIMER R. CAMIEL, M.D.
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Present-Day Indications for the Treatment of Tumors of the Oral Cavity, Larynx and Pharynx. A. Zuppinger. Strahlentherapie **95**: 161–177, October 1954. (In German)

Indications for the treatment of tumors of the oral cavity, larynx, and pharynx have changed since 1940, with progress in radiation therapy and surgery. Zuppinger comes to the following conclusions:

1. The use of antibiotics has greatly decreased the incidence of complications.
2. A tumor dose should be delivered in four to eight weeks; less than six weeks is preferred. This length of treatment should bear an inverse relationship to the rapidity of growth of the tumor.
3. In advanced cases, a treatment series with radiation may be divided into two parts.
4. A decrease of the individual dose toward the end of the series leads to better protection of the stroma and healthy tissues.
5. The tendency to treat small fields has the disadvantage that surrounding affected tissues may not be included.
6. Prophylactic treatment of the supraclavicular field is indicated in tumors of the pharynx.
7. Rotation therapy is not suitable for tumors of the oral cavity, larynx, or pharynx.
8. The use of cystein compounds for the treatment of radiation sickness should be postponed until we know more about the effect on the tumor itself.
9. In tumors of the hypopharynx, surgical removal of cartilage should precede radiation therapy.
10. In intrinsic laryngeal tumors, radiation therapy has practically the same end-results as surgery but is to be preferred because of superior functional results.

Three roentgenograms; 4 drawings; 5 tables.

EUGENE F. LUTTERBECK, M.D.
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Cancer of the Thyroid and Radiotherapy. Mackenzie Davidson Memorial Lecture. B. W. Windeyer. Brit. J. Radiol. **27**: 537–552, October 1954.

The series of cases upon which this discussion of cancer of the thyroid is based numbered 157, of which 112 were in women and 45 in men. There were included 32 cases of papillary adenocarcinoma, which is generally recognized as the most benign of the thyroid cancers, 26 alveolar adenocarcinomas, and 57 undifferentiated carcinomas.

The details of treatment are not always clear but the author arrives at the following conclusions:

"1. Radiotherapy has a place of some importance in the treatment of carcinoma of the thyroid when complete surgical excision cannot be carried out.

"2. Papillary adenocarcinoma will respond and in some cases clinical disappearance can be obtained by

external irradiation, but needs high dosage. The slow evolution and local nature of papillary adenocarcinoma until a late stage makes attempted surgical removal desirable whenever possible. External irradiation should be used whenever macroscopic disease is left behind.

"3. Alveolar adenocarcinoma does not regress completely after external irradiation, even with such high dosage [4,000 r and over], except for some of the less well differentiated forms. External irradiation is useful in alveolar adenocarcinoma as a palliative measure and may render metastases quiescent for some years.

"4. Undifferentiated carcinoma responds to external irradiation in about 50 per cent of cases. Five-year survivals can be obtained in patients who have not yet developed generalized metastases.

"5. Radioactive iodine is of particular value in well differentiated alveolar adenocarcinoma after destruction of normal thyroid function. This is probably the best method of irradiation for any case of thyroid cancer if adequate uptake can be induced."

Fourteen figures, including 20 roentgenograms.

Breast Carcinoma. The Influence of a Febrile Illness on an Arrested Case. Gwen Hilton. Lancet **1**: 900–901, Oct. 30, 1954.

The case presented here illustrates how a carcinoma of the breast with bone metastases, which had appeared to be stationary while under observation for nine years, suddenly became generalized after an acute febrile illness. The patient, when originally seen, had a lump in the right breast of eighteen months duration. No enlarged nodes were palpable in the right axilla or in the right supraclavicular region, and no pulmonary metastases were demonstrable roentgenologically. A radical mastectomy was performed, and the patient remained well for two years. She then complained of pain at the base of the back and down both legs. Roentgen examination of the pelvis and femora revealed several metastases, which were osteolytic, with a little surrounding sclerosis. No x-ray therapy was given to the metastases, but the pain subsided within two weeks and the patient became clinically well . Three years later an enlarged node was found on the medial wall of the right axilla. This regressed after irradiation. After another three years several nodes became palpable at the apex of the right axilla and in the right supraclavicular triangle. These also responded to radiotherapy. A year after this an enlarged node in the left supraclavicular triangle regressed following irradiation. Roentgen examination of the pelvis disclosed no extension of the metastases in the bones but only an increase in the surrounding sclerosis. After still another year (ten years after surgery) the patient had an acute febile illness during an influenza epidemic and never fully recovered. Her general condition deteriorated, she lost weight, pain returned in the lower back, and multiple skin metastases appeared in the mastectomy area. Roentgenograms of the pelvis showed a break in the sclerotic ring and an extension of the rarefied area. Irradiation of the skin deposits produced a temporary response only, and in two weeks they began to enlarge again and fresh nodules appeared. Bone metastases occurred in the left scapula, lumbar spine and pelvis, the general condition worsened rapidly, and the patient died.

This case demonstrates the importance of the defense mechanism of the body. It is not known whether the malignancy of the cancer cells increased after the illness, enabling them to break through the barrier which had enclosed them for years, or whether the other body defenses had become enfeebled by the febrile disease.

Three roentgenograms.

The Radium Treatment of Squamous Carcinoma in Cervical Lymphatic Nodes. Alexander A. Charteris. J. Fac. Radiologists **6**: 84–87, October 1954.

Although surgery is the treatment of choice for cervical lymph node metastases from well differentiated tumors when the node capsules are intact, it is not always practicable. When one has to deal with anaplastic tumors or where there is fixation of the nodes, radiotherapy is more appropriate. The experience with conventional x-ray apparatus and even with a 10-gram radium beam unit has, however, been disappointing except with radiosensitive lesions.

In the years 1942 to 1949 inclusive, cervical lymph node metastases in 92 patients were treated by percutaneous radium implantation. The great majority of the primary growths were in the tongue, while the remainder were in other buccal sites or in the skin. The earlier implantation fields measured 6 × 6 cm., with submental extension of several needles, but the dimensions were thereafter increased to 6 × 9 cm., with submental extension. The calculated dose was 6,000 gamma roentgens at 0.5 cm. distance from the needle plane, given in one hundred and sixty-eight hours. Skin damage in the form of limited patches of necrosis was seen in a very few of the early cases, where it was difficult to get the needles deep enough, but this can be avoided as experience is gained.

The cases were divided into four classes according to the state of the lymph nodes, and the results are reported as follows:

Stage I, no nodes palpable: 29 patients; 11 alive, 8 longer than three years.

Stage II, mobile palpable lymph nodes: 34 patients; 5 alive and 4 dead of other causes at three- and five-year intervals. The 5 who survived were apparently tumor-free for five years or longer.

Stage III, fixed palpable lymph nodes: 27 patients; 6 alive three years or longer.

Stage IV, massive nodes and fixation: 2 patients; no survivals.

From analysis of the results, it would appear that the method described is of value, since there was a total survival (three years) of 23 out of a total of 92 patients.

I. MESCHAN, M.D.
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The Adrenal Response to Irradiation on Patients with Testicular Tumors. Ward A. Soanes and Claude C. Dodson. J. Urol. **72**: 705–711, October 1954.

The authors studied 10 patients who received large doses of radiation for malignant disease of the testes. The urinary 17-ketosteroids, 11-oxycorticoids, total eosinophil count, white blood cell count, and hemoglobin were analyzed throughout hospitalization of approximately six months.

During periods averaging sixty-five to seventy days at the beginning of hospitalization, each of the patients received therapy with 220-kv roentgen rays, 300 r in air daily to one of nine portals until all areas had been treated anteriorly and posteriorly from the inguinal area progressively to the supraclavicular. The skin dosages came to 3,600 r for the inguinal and ab-

dominal ports, and 2,400 to 3,000 r for the chest and supraclavicular areas. These exposures were calculated to deliver total tumor doses of between 2,500 and 3,000 r.

In all patients the white blood cell count decreased during radiation therapy. The hemoglobin also decreased, particularly during the latter part of therapy, when the chest and mediastinum were being irradiated. The effects on the blood elements were considered to be the result of irradiating the hematopoietic system. Both the white blood cell count and the hemoglobin returned to normal after cessation of therapy.

Eosinophil counts generally paralleled the white blood cell counts. Exceptions occurred, however, in 8 of the 10 patients during the first forty days of treatment, when a marked rise in the total circulating eosinophil counts occurred during irradiation of the abdomen. At the same time these 8 patients exhibited a marked diminution in the output of 17-ketosteroids and 11-oxycorticoids. In 3 of the patients the steroid output remained low during the latter half of therapy and the convalescent period; in the other 5 it tended to return to normal after irradiation of the epigastric region had been completed. In all 8 the total eosinophil counts were lower than normal during the latter half of the period of therapy but returned to normal, together with the white blood cell count, in the convalescent phase. These patients tolerated the roentgen therapy poorly, particularly during irradiation of the epigastrium. The laboratory findings are considered to reflect a mild subclinical adrenocortical insufficiency.

The 2 other patients responded quite differently. A minimum of symptoms developed at any time during the treatment. Their eosinophil counts remained normal or depressed at all times. During treatment there was a constant increase in the output of 17-ketosteroids and 11-oxycorticoids. The response in these 2 patients is considered to be one of slight hyperfunction of the adrenal glands.

Five figures.

ARTHUR S. TUCKER, M.D.
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Treatment of the Cornea with a New Lilliput Roentgen Tube. P. J. L. Scholte, C. C. Kok-v. Alphen, and B. Combée. Acta radiol. **42**: 316–328, October 1954.

The authors present a description of an ingenious small tube with a beryllium window, which produces extremely soft radiation. Complete output charts are provided. The beryllium window actually acts as the anode.

In animal experiments and clinical experience in the treatment of the cornea of the eye (keratitis and corneal vascularization of the transplanted cornea), the results obtained with this new tube were found to compare favorably with those achieved with similar apparatus. One has the added advantage, with the new unit, of increased flexibility in the application of the radiation to the cornea.

[Comparison of data such as this is extremely difficult. The authors do a fairly good job, and it will be of interest to see further follow-up figures with larger numbers of cases.—C.E.D.]

Ten figures and diagrams; 1 table.

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Coronal Effects Observed While Rotating a Film Within an X-Ray Beam. Jesshill Love. South. M. J. **47**: 814–818, September 1954.

"Coronal effect" is a term applied to a ring shadow of less density distributed around the axis or "Herd" shadow of an exposed film rotated within an x-ray beam. This peculiar zone was first observed by the author while he was studying the possibility of using rotation therapy. An investigation of the particular x-ray machine being used revealed that the port was actually displaced laterally and superiorly approximately 1 cm. off the central axis. It was also discovered that the cone of an x-ray machine might be displaced both laterally and superiorly or inferiorly. Malalignment of the cone in either instance produced lighter zones around the rotation axis in the direction in which the displacement occurred, providing the film was rotated in that particular plane.

These studies indicate the necessity of x-ray beam control with anode-port axis alignment in rotation therapy, and the importance of using every physical aid available. Dose calculation and distribution plotting are necessary. The intricate details involved require a trained physicist or personnel well versed in this specialized form of therapy.

The author believes that every x-ray plant being used for any type of therapy should be carefully investigated for beam direction and mechanical alignment.

Twelve figures.

A New Method for Field Localization in X-Ray Therapy. G. Fuchs. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 527–529, October 1954. (In German)

The author discusses the need for accurate field localization in deep x-ray therapy. An ordinary x-ray cassette is used and the same tube distance as in therapy, but lower voltage and no filter. The film is developed and if the localization is accurate the field is then marked on the skin; otherwise corrections are made. The method is very simple and of great value in small bone lesions, esophageal lesions, lung and neck tumors. Three roentgenograms.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

RADIOISOTOPES

Radioactive Iodide Uptake of Normal Newborn Infants. L. Van Middlesworth. Am. J. Dis. Child. **88**: 439–442, October 1954.

Reported protein-bound iodine levels in infants one to three days old have averaged 12.0 gamma per 100 c.c., which is in the hyperthyroid range. I^{131} uptake studies have not been reported in this age group.

The authors carried out such studies on 7 boys two to three days old, weighing 7 to 9 pounds. Between 1.0 and 1.5 microcuries were used as a tracer dose, and a special scintillation counter was constructed for the investigation. The tracer dose was arrived at on the same weight basis as the 100-microcurie dose commonly used in adults, the results being divided by four to assure safety.

In 6 of the 7 infants, 60 per cent or more of the in-

jected I^{131} was taken up and retained in the thyroid area. Two of the subjects accumulated over 90 per cent of the test dose. The lowest uptake was 45.5 per cent, which would be borderline high for an adult. These studies are thus in agreement with the previously reported protein-bound iodine levels for infants of the same age.

The reason for a probable period of physiological hyperthyroidism in the newborn infant are discussed. This could be due to (*a*) increased sensitivity of the thyroid to thyrotropic hormone, (*b*) increased production of thyrotropic hormone, or (*c*) complex alterations of endocrine balance. Because several explanations are possible, no therapeutic implications are to be drawn from these data.

LAMAR BAIN, M.D.
Shreveport, La.

Radioiodine Tests in a Case of Struma Ovarii. John F. Foulkes and Russell Fraser. J. Obst. & Gynaec. Brit. Emp. **61**: 668–670, October 1954.

Since Boettlin in 1899 first described the presence of thyroid tissue in an ovarian cyst, many cases of struma ovarii have been reported, mainly in Germany and America. Only 3 cases, however, could be found in the literature of Great Britain during the past twenty-five years. The authors present another, in a 38-year-old woman. In this case, it was shown by means of radioiodine tests that the struma ovarii was functioning as normal thyroid tissue in conjunction with the thyroid gland. When the ovarian tumor was removed, the thyroid gland in the neck had to hypertrophy before resuming full activity, at about the nineteenth postoperative week. Previously impalpable, it became palpable for the first time at about the fifth week.

One photomicrograph; 1 table.

In Vitro Studies of the Intact Thyroid Gland. A. L. Botkin, C. D. Eskelson, H. E. Firsheim, and H. Jensen. J. Clin. Endocrinol. & Metab. **14**: 1219–1229, October 1954.

In order to circumvent the *in vivo* influence of possible peripheral utilization and excretion of the thyroid hormone with regard to the physiologic state of the thyroid, *in vitro* studies were undertaken on the effect of thyroxin, thiocyanate, and thyrotropic hormone (TSH) on the functional activity of the intact isolated gland. The authors used for their studies male hypophysectomized rats and their litter mates. Radioiodine was administered intraperitoneally before sacrifice and TSH was given at various time intervals. The thyroids were incubated under special conditions and the experiments were divided into 6 groups. (1) Effect of thyroxin on thyroid function; (2) effect of thiocyanate on thyroid function; (3) administration of TSH and I^{131} *in vivo;* (4) administration of TSH *in vivo* and incubation of gland *in vitro* with I^{131}; (5) administration of I^{131} *in vivo* and incubation of gland *in vitro* with TSH; (6) incubation of gland *in vitro* with both TSH and I^{131}.

Thyroxin was found to exert *in vivo* an inhibitory effect on the thyroid, presumably by inhibiting the release of TSH from the hypophysis. *In vitro* thyroxin apparently does not exert any influence on the release of inorganic and organic iodine from the gland. Thiocyanate inhibited the uptake of iodine by the thyroid. The *in vitro* studies with TSH and I^{131} indicated that the primary effect of TSH is to induce a release of hormone from the gland. Continuous stimulation of the thyroid by repeated TSH administration over a period of two to three days led to an increased content of inorganic and organic radioiodine in the gland.

Eight tables.

MARCO GONZALEZ, M.D.
Louisville General Hospital

Treatment of Polycythaemia Rubra Vera with Radioactive Phosphorus. D. Verel. Proc. Roy. Soc. Med. **47**: 857–859, October 1954.

Of 8 patients with polycythemia vera who had no previous therapy, 5 responded well clinically to P^{32}. Five patients who had previously received x-ray therapy all showed a good clinical response, with increasing duration of remissions following successive treatments. Favorable blood changes were not as striking as clinical appearances in either group.

Peripheral venous hematocrit and red cell counts may fail to indicate true changes in response to treatment because the increase in the blood volume of these patients may be corrected and symptomatic improvement noted without a change in hematocrit readings. Similarly, following remissions symptoms may recur due to increased blood volume before this change is reflected in the hematocrit. Fortunately blood volume determinations are usually not necessary in the control of this disease because, if the hematocrit is reduced to normal levels, the blood volume has also fallen to normal.

Two figures; 2 tables.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Some Experiences with Radioactive Phosphorus in the Treatment of Mycosis Fungoides. F. E. Neal. Proc. Roy. Soc. Med. **47**: 859–864, October 1954.

X-ray therapy, while beneficial in localized areas of mycosis fungoides, has been ineffective in the generalized form of the disease. The effect of P^{32} intravenously was observed in 5 such patients; 8 to 39 mc were administered over six to twenty-three weeks. The general condition of the patient and progress of the local disease determined the dosage.

Uptake measurements of normal skin and skin of the diseased area *in vitro*, as well as *in vivo* counting over normal and diseased areas, showed an uptake by the diseased skin three to seven times that in normal skin. Doses in the lesion were in the order of 15 rep/mc administered.

In all patients there was some relief of pruritus. Three showed noticeable improvement of skin lesions.

Nine photographs; 2 graphs; 2 tables.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Use of Radioactive Chromic Phosphate in Pleural Effusions. Melville L. Jacobs. California Med. **81**: 268–271, October 1954.

Radioactive chromic phosphate is a relatively new material which is used to control pleural effusions and ascites in the same fashion as is radioactive gold. The results with the two agents are comparable. Since most (90 per cent) of the ionizing radiation from Au^{198} is due to the beta particles emitted, the gamma component only complicates the safety factors. The dosage scale for gold ranges from 25 to 100 millicuries instilled into

the pleural space, and 50 to 100 millicuries into the peritoneal cavity, at one administration. That for chromic phosphate runs between 6 and 9 millicuries for pleural effusions and between 9 and 12 for ascites. It is necessary, in the case of gold treatment, that the patient remain at least 6 feet from other patients in order to keep the daily exposure within the maximum permissible limits. Since chromic phosphate has no gamma component, the need to protect personnel and patients from gamma radiation is obviated and handling of the material and health physics are simplified.

The details of the technic for injection of radioactive chromic phosphate are given in the original article and indicate that it is simpler to use than Au^{198}. At the City of Hope (Duarte, Calif.), 25 cases of pleural effusion and 12 cases of ascites were treated. The work was started in 1952 and is continuing. Of the 25 cases of pleural effusion, 17 were due to primary pulmonary neoplasms and 8 were due to metastasis from primary lesions located outside the chest (4 primary breast cancers, 1 testicular neoplasm, 1 kidney tumor, 1 rectal carcinoma, 1 ovarian carcinoma with both pleural effusion and ascites). Ascites was due to ovarian carcinoma in 9 cases and to primary breast cancer, carcinoma of the head of the pancreas, and carcinomatosis of unknown origin in 1 case each.

Fluid was controlled in the chest cases for one to fifteen months in 18 patients; failures occurred in 7 patients (28 per cent). In the patients with ascites, 9 were free of fluid from one to ten months and failures occurred in 3 (25 per cent).

Two photographs.

HARRY HAUSER, M.D.
Cleveland City Hospital

A 20 Curie Telecobalt Unit. J. H. Mellink. Acta radiol. **42**: 305–315, October 1954.

An excellent description of an ingenious 20-curie cobalt unit built at the University of Leiden Academic Hospital (Holland) is given. The treatment head, weighing over 900 kg., consists of two concentric spheres: an outer steel-encased lead sphere 54 cm. in diameter and an inner lead sphere 20 cm. in diameter, the latter lying in a spherical cavity in the outer sphere. The cobalt source occupies a hole on the surface of the inner sphere. The treatment head possesses three independent free movements.

Owing to the rather small output of the unit, the source-skin distance can be only 25 cm. at the most. The diaphragm-skin distance must therefore be relatively short in order to prevent too large a penumbra. Two applicators, constructed to date, are described: one for laryngeal cancer with a source distance of 25 cm. and a circular irradiation field 5 cm. in diameter; the other for experimental studies, with a source-skin distance of 15.5 cm. and a 2-cm. field.

The treatment room has concrete inner walls and brick outer walls. Observation of the patient during irradiation is made possible by a periscope mounting with two plane mirrors and a small hole in one of the walls about 150 cm. above the floor.

Depth dose charts for use with the unit have been made, and the figures are presented in tabular form.

This is an excellent presentation and is recommended to anyone interested in this type of therapy.

Seven figures; 2 tables.

C. E. DUISENBERG, M.D.
Palo Alto, Calif.

Three Years' Use of a Cobalt 60 Unit. E. W. Emery. Proc. Roy. Soc. Med. **47**: 853–857, October 1954.

Sixty curies of Co^{60} were installed in a radium telecurietherapy unit. Uranium shielding and applicators were substituted, but the room protection requirements were unchanged. The cobalt is kept in a safe and blown *via* a delivery tube into the unit head at the treatment time only. Maintenance costs are minimal and the radiation is equivalent to supervoltage x-rays up to 3 mev (h.v.l. 10.5 mm. Pb). At 20 cm. skin-source distance the output is 20 r/min. Maximum field size is 12.5 × 15 cm. Isodose curves are similar to those for 250-kv x-rays (h.v.l. 2.3 mm. Cu) at 50 cm. focal-skin distance.

Decreasing the skin-source distance to 8 cm. (180 r/min. output) and intermediate distances gives variability to depth doses and clinical usage.

It is felt that the lessened skin reaction and increased bone penetration add to the clinical usefulness of this type of beam.

Four figures.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

A Technique for Evaluating the Effectiveness of Localization of Radioactive Colloidal Gold-198 After Direct Injection into Tumors. John U. Hidalgo, Edgar Burns, and Robert T. Nieset, with the technical assistance of Richard Fleck. Am. J. Roentgenol. **72**: 658–660, October 1954.

A method for determining the distribution of radioactive colloidal gold after its injection into the body is described. It is a combination of radioautographic and roentgenographic technics, as follows:

(1) A large cassette is placed beneath the supine patient so that the pelvis and as much as the thoracic cage as possible will be on the film. If the procedure is done immediately after injection, the cassette remains under the patient for four minutes. If done later, an adjustment is made for the decay of the radioactive gold. A four-minute exposure is sufficient to produce a satisfactory radioautographic film for a patient with a dosage of 100 mc.

(2) At some time during the exposure, a portable roentgenographic unit is wheeled into position over the patient and a light exposure is made. The machine is set to deliver 5-kv roentgen rays for 0.5 second at 14 ma. The film is processed and kept for evaluation. A second exposure is made under identical conditions, except that the time is reduced to 0.2 second. The longer exposure is to evaluate the gross distribution of the radioisotope after injection. The short exposure film is similar except that the bone structure is very faintly outlined. These films are made light so that image densities can be measured.

Film density measurements are made over the injection site, liver, spleen and a point on the film midway between the liver and spleen readings. Such measurements have been made on 11 patients. With the midline value at the height of the liver and spleen as a "background density," the densitometer data are as follows:

Position	Light Absorption (per cent)	Image Density (arbitrary units)
Tumor site	87.0	0.590
Liver	33.2	0.014
Spleen	11.7	0.007

By comparison of image density values, it can be seen that concentration in the tumor is roughly 42 times that in the liver. The liver concentration is about twice that of the spleen.

The procedure described above permits a routine check of the effectiveness of the direct injection of radioactive colloidal gold. Evaluation of its gross distribution picture and comparative data on unit concentration in the tumor, liver, and spleen can be rapidly and simply made.

Two roentgenograms.

H. C. JONES, M.D.
Grand Rapids, Mich.

Surgical Complications Associated with Intraperitoneal Colloidal Radiogold. C. Jules Rominger. Am. J. Surg. **88**: 574–579, October 1954.

Two cases of abscess and intestinal fistula formation have been reported following the instillation of radiogold into the peritoneal cavity (Nolan: Second National Cancer Conference, Cincinnati, Ohio, 1952). The author reports a third case presenting these complications accompanied by gas infection and necrosis of the abdominal wall.

It is his belief that the major complications in this case can be explained purely on the basis of surgical procedures. Prior to the introduction of the radiogold, paracentesis had been done on several occasions. At the third paracentesis, some difficulty was experienced in inserting the trocar, and several days later a localized cellulitis developed at the insertion site. This never completely subsided and the possibility of injury to the bowel was entertained. On the instillation of gold, about a month thereafter, an abscess cavity was entered and the bowel wall may have suffered further injury. Eight days later a fecal fistula developed. Massive cellulitis of the abdominal wall due to a gas-forming organism ensued, and necrosis developed in two large areas.

It is recommended that intraperitoneal instillation of Au^{198} should always be performed through an abdominal incision made in an area remote from a large tumor mass or previous incisions for paracentesis and operative procedures. The instillation should never be made through a trocar.

Two roentgenograms; 1 photograph.

THOMAS E. PADGETT, M.D.
University of Louisville

Suggested Procedure for Performance of Autopsies on Radioactive Cadavers. Russell F. Cowing and Egilda DeAmicis. New England J. Med. **251**: 380–382, Sept. 2, 1954.

A practical working procedure for the performance of autopsies on cadavers containing radiogold is described. It is based largely on information about radiation exposure contained in the National Bureau of Standards Handbook 56, Safe Handling of Cadavers Containing Radioisotopes.

Two tables.

The Use of Radioactive Sulphur Labeled Methionine in the Study of Protein Catabolism in Burn Patients. T. G. Blocker, Jr., William C. Levin, S. R. Lewis, and C. C. Snyder. Ann. Surg. **140**: 519–523, October 1954.

The authors have made use of methionine labeled with sulfur 35 in a series of experiments for the study of protein catabolism in burn patients and believe it to be valid for investigative purposes.

Eighty to one-hundred microcuries of methionine labeled with sulfur 35 was administered intravenously. Blood samples were collected at appropriate intervals prior to and following such administration. Activity of all samples, as well as of the standard, was measured in duplicate, using a proportional flow gas counter as the detector. This instrument was chosen because sulfur 35 decays by the release of only a very soft beta particle. The activity of the total serum protein was measured as well as the non-protein activity of the serum. The globulin fraction was quantitatively removed by salting out with sodium sulfite, and the activity of the globulin was assayed.

Fourteen normal patients were used as controls and in but one instance was there any obvious metabolic abnormality. In all patients the peak of radioactivity of the serum was observed to occur three to five hours after injection. At this time the approximate percentage of activity in the total plasma volume was about 7 per cent of the total injected activity. In the next four days there was a gradual fall of the serum radioactivity so that the average at the end of the fourth day following the injection was 50 per cent of the peak. In the control patients only 1 to 5 per cent of the serum activity was present in the protein-free portion of the serum. Therefore, 95 to 99 per cent of the activity was due to actual radioactivity of the serum protein. For these reasons it seems safe to assume that the labeled methionine is rapidly incorporated into the body protein, as evidenced by the pronounced degree of its incorporation into the serum proteins. After the fourth day, it appeared that a plateau was established, with little further decrease in serum activity up to the twenty-first day, suggesting that by the fourth day the labeled methionine is thoroughly incorporated into the body proteins and that a state of equilibrium is established in regard to the relationship of the methionine to the protein pool in general.

Similar studies were performed in 10 burned patients. In those who were severely burned, the peak serum activity was only 8 to 30 per cent. Here also it was evident that the serum activity was contained chiefly within the protein portion of the serum. The plateau referred to above was achieved at much lower levels, and the drop from the peak level was more rapid, with a lack of establishment of equilibrium and decreases in activity of 4 to 10 per cent from the third to the twenty-first day.

Past experimentation has shown that there normally exists a state of protein metabolic equilibrium, with all foodstuffs entering the body being broken down into their respective smallest units. In "balance," the rate of protein synthesis approximates the rate of protein catabolism, so that nitrogen intake and output are equal. In burned patients, on the other hand, this state of equilibrium with regard to protein metabolism, as measured by sulfur-tagged methionine, appears not to develop. There is a precipitous fall from the initial peak levels which is more rapid than in normal patients, and a true plateau is not observed. This finding permits the assumption that the rate of catabolism of body proteins in general is greatly increased following extensive thermal trauma.

Two graphs; 2 tables.

WINSTON C. HOLMAN, M.D.
Shreveport, La.

Studies on the Thyroidal Uptake of Astatine in the Rat. C. J. Shellabarger and John T. Godwin. J. Clin. Endocrinol. & Metab. **14**: 1149–1160, October 1954.

Studies with radioactive astatine (At^{211}), the newest and heaviest radio halogen, reveal that the thyroid gland in rats selectively concentrates this element, though to a lesser extent than I^{131}. The apparent difference in uptake was less evident as the interval between administration of the isotope and sacrifice of the animal was shortened. Thiouracil administration enhanced the thyroidal uptake of astatine and only in glands so treated were clusters of alpha tracks observed. These were believed to represent aggregates of astatine atoms.

Five radioautographs; 1 graph; 5 tables.

S. G. BELOTE, M.D.
University of Louisville

The Accumulation and Destructive Action of Astatine^{211} (EKA-Iodine) in the Thyroid Gland of Rats and Monkeys. Joseph G. Hamilton, Patricia W. Durbin, and Marshall Parrott. J. Clin. Endocrinol. & Metab. **14**: 1161–1178, October 1954.

Following the administration of At^{211}, growth pattern changes in rats and monkeys as a result of both acute radiation injury and endocrine changes have been observed. At^{211} is capable of apparently complete destruction of the thyroid gland without any injury to the parathyroid glands and adjoining structures. A high incidence of mammary tumors following the administration of At^{211} was an unexpected observation, thought to be due to endocrine changes rather than radiation effects.

Fourteen figures.

S. G. BELOTE, M.D.
University of Louisville

RADIATION EFFECTS

Histologic Effects of Various Types of Ionizing Radiation on Normal and Hyperplastic Human Thyroid Glands. Stuart Lindsay, Morris E. Dailey, and Malcolm D. Jones. J. Clin. Endocrinol. & Metab. **14**: 1179–1218, October 1954.

This interesting study is concerned with the histologic changes in human thyroid glands following administration of I^{131}, external irradiation with x-rays and with neutrons, and implantation of radon seeds. The changes observed in the glands treated by these various methods were qualitatively similar. The initial lesion following high-dosage irradiation was acute epithelial injury associated with necrotizing vasculitis and thrombosis. Follicular atrophy and perifollicular fibrosis were late reactions.

These studies were performed on 58 normal and hyperplastic human thyroid glands, Twenty-four patients received I^{131} for toxic diffuse goiters and 5 for toxic nodular goiters. Eleven patients with hyperthyroidism were treated by external x-ray irradiation and 9 by radon implantation. Two euthyroid patients received I^{131}; 5 euthyroid patients were irradiated externally (mostly for laryngeal cancer), and 2 patients were irradiated by neutrons from a 60-inch cyclotron.

The effect of irradiation from I^{131} was found to depend upon the rate of uptake and the release of the radioactive substance. Functional alteration causing decreased thyroid hormone production resulted from cellular injury by I^{131}. This injury did not produce visible cellular lesions though changes regarded as those of exhaustion were seen.

Glands treated by x-rays underwent various degrees of exhaustion changes of the follicular epithelial cells, with 5 of the toxic glands and 1 of 5 normal glands showing Hashimoto thyroiditis.

In both the x-irradiated hyperplastic glands and in those treated by I^{131}, the incidence of Hashimoto thyroiditis was significantly high. The epithelial proliferative reaction in 2 of these glands led to the late development of multiple adenomas. These findings suggest the possibility of eventual development of malignant lesions in the irradiated hyperplastic human thyroid, though no cases of carcinoma were observed in this series, and one group of workers is said to have found no instance in 400 patients treated with I^{131} during the past ten years (Dobyns *et al.*: J. Clin. Endocrinol. & Metab. **13**: 548, 1953. Abst. in Radiology **62**: 473, 1954).

Glands irradiated by radon seeds revealed the most marked fibrous tissue near the sources and hyperplastic changes with minimal colloid in the follicular spaces toward the periphery. Neutron bombardment produced moderate interlobular fibrosis with some small and atrophic follicles accompanied by follicles of normal size or slightly enlarged.

In general the hyperplastic cell appeared more sensitive than the normal cell.

Twenty-six photomicrographs.

JOHN F. BERRY, M.D.
University of Louisville

Some Effects of Radiation on the Lymphoid Cells. D. O. Shiels. M. J. Australia **2**: 583–586, Oct. 9, 1954.

A group of 93 apparently healthy adults were studied by means of microscopic examination of stained blood films for evaluation of possible cytologic changes referable to radiation exposures. Thirty-six of the group had had no known exposure to ionizing radiations and the remainder had had exposures not in excess of the currently accepted maximum permissible safe dose. Many cells on each blood slide were observed and counted. A ratio was determined between the monocytes plus large lymphocytes to small lymphocytes. The percentage of lymphocytes showing cytoplasmic granules was calculated. The resulting figures were subjected to statistical analysis and the following conclusion is drawn: Persons exposed to harmful radiations show a decreased number of small lymphocytes and a considerable increase in the percentage of lymphocytes with cytoplasmic granules.

It was not possible to correlate the findings directly with the actual individual exposures nor was it possible to estimate the degree of exposure. Additional studies are currently under way.

Two tables.

J. W. BARBER, M.D.
Cheyenne, Wyo.

Radiation Cancer of the Pharynx. Ronald W. Raven and V. B. Levison. Lancet **2**: 683–684, Oct. 2, 1954.

A 46-year-old woman was seen with cancer of the hypopharynx twenty-three years after receiving radiotherapy for thyrotoxicosis. It is calculated that a dose of 8,000 r was delivered to the thyroid gland and 10,000 r to the post-cricoid region of the pharynx.

A review of the literature revealed 10 cases of cancer

of the larynx following irradiation (including the present case). Seven patients had received radiotherapy for goiter and 3 for tuberculous adenitis; the average interval between radiotherapy and the development of the pharyngeal cancer in these cases was twenty-five years.

The Treatment of Radiation Sickness with Sulfhydryl Compounds and Its Problems. Heinz Heuwieser. Strahlentherapie **95**: 330–332, October 1954. (In German)

Subjective symptoms of radiation sickness are relieved by cystein and cysteamine medication. The author reports 50 cases in which 0.2 gm. were given intravenously either shortly before or after radiation treatment. Seventeen patients were symptom-free, 31 markedly improved, and only in 2 cases was the method ineffective.

It is pointed out that there is a possibility that with the administration of cystein and cysteamine the radiosensibility of the tumor itself may also be reduced. This has been demonstrated by the work of Hall (Cancer Research **12**: 787, 1952. Abst. in Radiology **61**: 314, 1953) and Storaasli *et al.* (Cancer **6**: 1244, 1953. Abst. in Radiology **63**: 626, 1954) on the effect of these compounds on tissue cultures and rat lymphosarcoma.

At present only severe radiation sickness should be treated with sulfhydryl compounds, preferably after completion of a series. They seem most suitable for the treatment of radiation sickness due to atomic explosions or other radioactive exposures.

EUGENE F. LUTTERBECK, M.D.
Urbana, Ill.

Film Badge Dosimetry: How Much Fading Occurs? William L. McLaughlin and Margarete Ehrlich. Nucleonics **12**: 34–36, October 1954.

Latent-image fading in photographic emulsions for storage periods up to eight days has been studied. The fading of the latent image is believed to be a predominantly chemical effect. It is important to establish its magnitude in connection with the use of emulsions for dosimetric purposes. This is of particular importance in view of the extensive use of commercial radiographic and photographic film which has been subjected to extreme conditions of temperature and humidity and whose processing may have been delayed.

Six types of films were used in this study: two types of radiographic film, a radiation monitoring film, contact printing paper, cine-positive film, and spectroscopic film. The amount of fading varied widely for the different types. Results are plotted in a figure which also indicates the approximate grain size of the films.

An empirical expression is also applied by the authors to their data. With the choice of suitable constants, it is possible to predict successfully the amount of fading for the different kinds of film studied.

One figure.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, New York

RADIOBIOLOGY; RADIOPHYSICS

Pathogenesis and Pathology of Post-Irradiation Infection. V. P. Bond, M. S. Silverman, and E. P. Cronkite. Radiation Res. **1**: 389–400, October 1954.

Susceptibility of Irradiated Animals to Infection. I. L. Shechmeister. Ibid., pp. 401–409.

The Treatment of Post-Irradiation Infection. Carolyn W. Hammond. Ibid., pp. 448–458.

The Effects of Ionizing Radiation on Immunity. William H. Hale and Richard D. Stoner. Ibid., pp. 459–469.

The papers listed above were read in a symposium on "The Role of Infection in Radiation Injury," presented before the Society of American Bacteriologists in August 1953.

Bond, Silverman, and Cronkite discuss the role of infection in deaths after radiation damage. They conclude that mortality in animals suffering from the intestinal syndrome results from severe changes in fluid and electrolyte balance leading to dehydration and vascular collapse; infection appears to be a relatively minor contributing factor.

The life of a survivor of the intestinal syndrome or an individual exposed to lower doses of radiation and giving evidence of the hemopoietic syndrome is in reality exposed to triple jeopardy, in probable order of importance: (a) infection, (b) hemorrhage, (c) anemia.

Radiation intoxication is most logically correlated with the severe dehydration in the intestinal syndrome and bacterial intoxication in the hemopoietic syndrome.

Infection is possible because of the severe leukopenia and impaired immune responses. It is precipitated by parenteral injection of or exposure to pathogens, or by loss of integrity of the internal or external body surfaces, permitting free access, growth, and diffuse invasion of commensal organisms.

Hemorrhage is possible mainly because of the thrombocytopenia and may be spontaneous or induced by minor traumata (defecation, coughing, vomiting, etc.) or by bacterial ulceration.

Obviously, continued survival is impossible if marrow does not regenerate even if infection is controlled by antibiotics and anemia and thrombocytopenia are controlled temporarily by transfusion.

Shechmeister reviews the literature on the susceptibility of irradiated animals to infection. In summary, he states that the importance of infection in radiation injury is indicated by the findings that different species of animals exposed to lethal or to sublethal doses of x-radiation are particularly susceptible to experimental infection and that bacteremia produced in these animals as a result of irradiation is an important factor in radiation death. In studies in this field it is essential that the role of the post irradiation period as well as the radiation dose and challenge dose be considered. Sublethal radiation has been found to activate subclinical or latent infections in mice and possibly in rats.

Miss Hammond's paper reviews the pertinent experimental studies which have contributed to the problem of post-irradiation infection and its treatment. From these studies it would appear that infection plays a prominent role in death from ionizing radiation. Furthermore, it seems safe to say that a considerable degree of success, particularly in the case of the mouse, has been obtained in treating post-irradiation infection by means of antibiotics. A possible explanation of the success is that irradiated animals which were not too severely damaged were carried over the crucial period

when their natural defense mechanisms were impaired. Once these had regenerated and could function adequately, the animal was able to cope with bacterial invasion. That this explanation is feasible is borne out by the protection obtained against infection by the injection of bone marrow or spleen homogenates.

Miss Hammond warns against extrapolating directly to man the results of the experimental work in laboratory animals. There is a species difference in response to various methods of therapy. Man is another species, and his reactions may vary still further. In addition, he has not only his intestinal flora but his nasopharyngeal and cutaneous flora to serve as possible sources of post-irradiation infection.

Hale and Stoner limit their discussion to whole-body ionizing radiation effects on (a) resistance and acquired immunity to various organisms, (b) passive immunity, and (c) antibody formation. Their conclusions are as follows:

Ionizing radiation markedly reduces or abolishes active or passive immunity to bacterial infections and reduces resistance and active immunity to animal parasite infections.

Ionizing radiation has little, if any, effect on acquired immunity to viral infection, and it does not significantly depress active or passive immunity to bacterial toxins.

Antibody formation is greatly inhibited by ionizing radiation. There does not appear to be convincing evidence for stimulation of antibody production by small doses of radiation.

The Effect of Total Body X-Irradiation on Hepatic and Renal Function in Albino Rats. Kee-Chang Huang, James R. Almand, and Lila A. Hargan. Radiation Res. **1**: 426–436, October 1954.

In an investigation of the effect of irradiation on hepatic and renal function, a single dose of total-body irradiation, 806 r or 600 r, was given to albino rats weighing 150 to 300 gm. This dose is approximately equal to the LD 50 and is sufficient to cause loss of body weight, malaise, diarrhea, alopecia, a rapid marked decrease of white cell count, an increase of sedimentation rate, and a gradual fall of hematocrit. Control animals without irradiation were kept in the same environment and used for comparison each day.

The livers in only 3 of 63 irradiated rats (5 per cent) lost their capacity to inactivate antidiuretic hormone. No morphological change in the liver was observed.

Studies on the pre- and post-irradiation renal clearances of 7 male rats revealed a decrease of glomerular filtration rate and tubular excretion in only 1 animal. One other animal showed a marked fall of glomerular filtration rate with slight decrease of PAH (*p*-aminohippuric acid) clearance.

In the first twelve days following irradiation, the PAH uptake and Qo_2 of kidney slices were lower than for the daily control. Following that period, both the PAH uptake and Qo_2 returned to normal.

Four figures; 1 table.

Effect of Total Body X-Irradiation on Serum Electrolyte Levels and Electrocardiograms of the Golden Hamster. George P. Fulton and Frederick N. Sudak. Am. J. Physiol. **179**: 135–138, October 1954.

A study was undertaken to determine the effect of various dosages of total-body irradiation on the serum electrolyte levels and electrocardiograms of the golden hamster. Eighty-eight male hamsters weighing 80 to 100 gm. were irradiated in three groups: 24 at 1,500 r, 24 at 1,000 r, and 40 at 600 r. Irradiation factors were 130 kvp, 4 ma, 100 r/min., target distance 10 cm.; the only filtration was that inherent in the tube. Serum electrolyte levels and electrocardiograms were obtained on all hamsters three days prior to irradiation, and on a sample of 6 hamsters in each group every day following irradiation until death. Although blood samples were obtained by cardiac puncture, no abnormalities were detected in the electrocardiograms or electrolyte levels attributable to this procedure. The circulation in the cheek pouch was observed by transillumination at low power (7×) before every cardiac puncture and electrocardiographic recording.

Disturbances in serum potassium and sodium, in the electrocardiogram, and in the circulation in the cheek pouch were present terminally in the hamsters receiving 1,000 r. The potassium and sodium concentrations were significantly increased and decreased respectively. Electrolyte imbalances were accompanied by progressive decreases in the amplitude of both the T and P waves on the electrocardiograms. Bradycardia, depression of the S-T segment and, in some cases, prolonged Q-T intervals and reversed T waves were found near death. Severe vasoconstriction was noticed simultaneously with electrolyte and electrocardiographic disturbances. Slight increases in serum potassium were observed in individual hamsters after irradiation with 1,500 r, but the mean values were not statistically significant. Hamsters irradiated with 600 r showed no significant alterations in serum electrolyte levels, electrocardiograms, or blood vessels in the cheek pouch.

One figure; 1 table.

Lack of Effect of Adrenalectomy on Tumor Regression Following X Irradiation. Joanne Weikel Hollcroft and Marion Matthews. J. Nat. Cancer Inst. **15**: 353–358, October 1954.

The authors describe an investigation of the possibility that the synergistic effect of whole-body irradiation is mediated through the adrenal glands.

CAF_1 male mice three to four months of age were inoculated with lymphosarcoma 1 (formerly referred to as lymphoma 1) and four or five days later were submitted to bilateral adrenalectomy or to a sham operation. One or two days after the operation, the adrenalectomized animals were given a single injection of 0.1 c.c. lipoadrenal-cortex. The animals were irradiated twelve to fifteen days after transplantation when the tumors were about 1 c.c. in volume. In the first series of experiments two groups of mice were given total-body irradiation of 300 r (77 r per minute). In a second series of experiments, half the adrenalectomized and half the sham-operated animals were given 1,000 r (226 r per minute) to the tumor; the other half were given 1,000 r to the tumor and 50 r to the body.

The adrenalectomized mice showed the same degree of tumor regression following 300 r whole-body, 1,000 r local tumor, or 1,000 r plus 50 r body irradiation as did the sham-operated animals. Adrenalectomy did not modify tumor regression. It can therefore be concluded that the synergistic effect of whole-body irradiation does not operate through the adrenal glands.

Two charts; 1 table.

Effect of Granulocyte Count and Litter on Survival of Irradiated Mice. Willie W. Smith, Leon Gonshery, Ilo Alderman, and Jerome Cornfield. Am. J. Physiol. **178:** 474–476, September 1954.

When sublethally irradiated mice are challenged by the injection of bacteria, the identity, degree, time, and route of infection are subject to control. Under these circumstances the authors have previously demonstrated an association between resistance to *Pseudomonas aeruginosa* infection and granulocyte count, but none between resistance and lymphocyte count (Smith, Marston, Ruth, and Cornfield. Am. J. Physiol. **178:** 288, 1954. Abst. in Radiology **64:** 914, 1955). In the present experiments these relationships were studied in mid-lethally irradiated mice, infected spontaneously by various organisms which normally inhabit the intestinal tract. In addition, this experimental material proved suitable for an investigation of the observation of Kaplan and Brown (J. Nat. Cancer Inst. **12:** 765, 1952. Abst. in Radiology **60:** 160, 1953) on the tendency of survivorship to be a characteristic of litters, as well as for studies of the litter distribution of granulocyte count and of bacterial species cultured after death from the blood of irradiated mice.

Three hundred male N.I.H. mice were given 500 r at nine weeks of age. Radiation factors were 200 kvp, 20 ma, 0.55 mm. Al and 0.25 mm. Cu added filtration, 50 cm. target distance, and approximately 55 r/min. (in air). Mice living twenty-eight days after irradiation were counted as survivors. Total leukocyte and differential counts were made on tail blood four days after irradiation in one group of animals and seven days after irradiation in another. Survival of these mid-lethally irradiated mice was found to be associated with the granulocyte count taken at these intervals. There was no association between lymphocyte count and survival. The clustering of survival in litters was highly significant in contrast to the clustering of relatively high granulocyte counts. The occurrence of *Pseudomonas*, *Proteus*, *α-Streptococcus*, and negative cultures (but not *E. coli*) in postmortem blood showed a significant litter effect.

Spleen Adenosine Triphosphatase Activity in Irradiated Mice Treated with Spleen Homogenate. Willie W. Smith, William Anderson, Jr., and Gilbert Ashwell. Am. J. Physiol. **178:** 471–473, September 1954.

Changes in adenotriphosphatase activity, spleen weight, and leukocyte count were studied in 296 LAf_1 mice after irradiation of 650 r (LD 75). About half of the animals were given a single intravenous injection of spleen homogenate, equivalent to the spleen of one two- to three-week-old donor, within a few hours after irradiation. Streptomycin (given to both treated and untreated groups) was used to increase survival in the irradiated controls.

The duration of spleen involution and high adenosine triphosphatase activity was found to be much shorter, and subsequent hypertrophy and low adenosine triphosphatase activity to be less marked, in the homogenate-treated mice than in the irradiated controls. There was little change in total spleen adenosine triphosphatase in homogenate-treated animals, while in the controls this was below normal for three weeks following irradiation and higher than normal in the fourth week.

Studies on the Transfer of Lymph Node Cells. IV. Effects of X-Irradiation of Recipient Rabbits on the Appearance of Antibody after Cell Transfer. T. N. Harris, Susanna Harris, Henry D. Beale, and J. J. Smith. J. Exper. Med. **100:** 289–300, Sept. 1, 1954.

Cells of the popliteal lymph node were teased three days after the injection of *Shigella paradysenteriae* into the hind foot pads of rabbits. These cells were transferred to normal animals and animals exposed to 425 r whole-body x-irradiation twenty-four hours earlier. The serum titers of dysentery agglutinins in irradiated recipients were found to be higher than in the normal recipients. This was represented both in a higher peak titer and a tendency to remain higher for a longer period than in normal animals.

In another experiment recipients were irradiated within one hour after receiving cells of the lymph node prepared as above. The serum titers of these recipients were markedly reduced in comparison with those of non-irradiated control animals. If the irradiation of the recipients followed the transfer of cells by a day, however, this difference was much smaller and in the case of a two-day interval after the transfer of the lymph node cells the irradiation appeared to have no effect on the resulting serum titer.

Four graphs; 1 table.

Late Effects of Thermal Neutron Irradiation in Mice. A. C. Upton, J. Furth, and K. W. Christenberry. Cancer Res. **14:** 682–690, October 1954.

While several reports have appeared on the acute effects of thermal neutron irradiation in mice, the late pathological changes resulting from exposure to slow neutrons have been analyzed only incompletely.

Sibling male and female RF mice, six to eight weeks of age, were divided into various groups for exposure to x-rays and to thermal neutrons from a graphite reactor. The highest dose given (LD 50/30) required exposure for approximately eighty minutes at the lowest position within the graphite chamber (to a flux of 0.9×10^9 thermal neutrons/cm.^{2}/second, with 6.5 r/min. of contaminating gamma rays). Exposures in the reactor were matched by doses of x-irradiation producing equal lethality. Eighty minutes in the thermal column at the top of the box (3.3×10^{12} n/cm.^{2} + 416 r of gamma radiation) corresponded to eighty minutes of 250-kvp x-irradiation at 6.4 r/min., or 512 r (LD 3/30 days). The factors of x-radiation were 250 kvp, 12.5 ma, 3.5 mm. Cu filtration, target-skin distance 93.7 cm., rate 6.4 r/min.

Thermal neutron irradiations and x-rays appeared not only qualitatively identical in their effects on mice, but, matched in terms of acute lethality, they appeared biologically equivalent at each dose level for most late pathologic effects, such as induction of leukemia and other neoplasms and reduction of longevity, as well as for early hematologic effects. From this it would seem that the relative biological effectiveness of pile radiations was relatively constant for most of the parameters in question. A notable exception was cataract. Thermal neutron-gamma radiation was several-fold more damaging to the lens than x-irradiation, in doses of equivalent acute lethality.

The RF mouse, like man, is susceptible to induction of myeloid leukemia by relatively low doses of ionizing irradiation.

Ten charts; 3 tables.

Electron Energy Distributions Produced by Gamma-Rays. H. E. Johns, J. E. Till, and D. V. Cormack. Nucleonics **12**: 40–46, October 1954.

The calculation of the amount of energy deposited by gamma rays in any medium, liquid, solid or gaseous, requires a knowledge of the spectrum of the secondary electrons associated with the absorption of the gamma rays. For many purposes it is sufficiently accurate to know the initial spectrum of the secondary electrons, though the total electron spectrum is more degraded than the initial spectrum. The tables in this paper permit calculation of the initial electron spectrum.

A series of tables are presented which give the number of electrons initiated in a given energy interval produced by the absorption of photons of various energies from 0 to 30 mev. Secondary electrons produced by the Compton, photoelectric, and pair production processes are tabulated separately. To determine the electron flux in terms of electrons/cm.^{2} passing a given point from the calculated spectrum of electrons initially set in motion/cm.^{3}, a conversion calculation is required. An integral expression involving the reciprocal of the stopping power of the secondary electrons in the medium is developed, which makes possible the conversion of the initial electron density into flux. The procedure in calculating the distribution of ion density along the secondary electron tracks is also described.

The procedures and tables in the article are applied to the specific case of the x-rays produced by a 3-mev machine with filtration of 10 mm. of lead and 5 mm. of copper. For water this calculation resulted in a value of approximately 91 ergs/cm.^{3} of energy absorbed/unit ionization of 1 e.s.u./c.c. A more accurate treatment of energy absorption would require a total electron spectrum rather than merely the initial spectrum, but this is unnecessary for most clinical and biological cases.

Five figures; 8 tables. JOHN S. LAUGHLIN, Ph.D.
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X-Radiation from Electronic Power Tubes. S. C. Ballard. Arch. Indust. Hyg. & Occup. Med. **10**: 328–335, October 1954.

This paper is concerned with the problems encountered in the detection and measurement of x-radiation from the operation of an electronic power tube. Such tubes are used for radar, in microwave apparatus, in induction heaters, and as capacitors and condensers. They operate at voltages ranging from 5 kv to a potential of 400 kv and include the hydrogen thyratron, magnatron, and klystron. In all cases there is a source of electrons, a potential target in the form of the anode, and, when voltage is sufficient, x-rays will be produced.

The author describes an investigation of possible exposure to x-rays from a hydrogen thyratron tube which was in use as an experimental radio frequency modulator for high-voltage studies. As a result of his findings, he concludes that it is essential to provide adequate protective barriers to attenuate x-radiation from such tubes. This refers to experiments for high-voltage studies and operational use. There is a strong indication that other electronic power tubes should likewise be investigated.

Five illustrations; 4 tables.